The Allahabad Farmer

A BI-MONTHLY JOURNAL OF AGRICULTURE
AND RURAL LIFE

Vol. XVI] JANUARY, 1942 [No. 1

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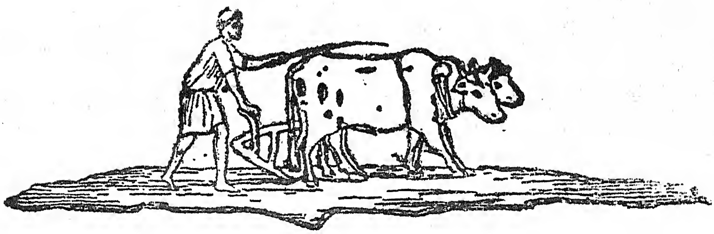

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Editorial

Special number

This number of the Allahabad Farmer is a Report Number. We are frequently asked for copies of our Annual Report and we have to confess that we do not publish such. An Annual Report of the Principal and the Treasurer is submitted to the Board of Directors to show as far as possible, the state of affairs at the Institute These reports are seldom drawn up in a manner which would make them suitable for publication.

This year in order that our friends may know that the Institute is a going concern we are putting out this special number. The reports are from the different departments and give an idea of the equipment and activities being carried on.

The Institute is primarily an educational institution, one of whose aims is to teach an Indian young man how to get a living by farming, either his own land or rented land. This involves not only the growing of crops and raising of livestock, but the marketing of the crops grown. If under as

near commercial conditions as possible, we cannot recover the expenses of production plus a small surplus, what good is it ? Unless we can prove that with intelligent hard work the graduate of this institution can get a living at farming there is little use of continuing the work. Few men need to spend four college years learning how to lose money at farming. So frankly and unabashed the education we offer is in the best sense "dollar" education. It should help those receiving it to do what is so often considered common place and routine, to earn a decent living. This is surely one of the highest aims of every honest and intelligent man. Such a living should enable him to maintain himself and his family without retrogression; should provide education for the children, suitable housing and the ordinary amenities of civilized life. Unfortunately the farmers of this part of India make little progress from generation to generation. The Institute wishes to break this vicious circle.

I could comment at length on each aspect of the work here. But I must content myself with brief remarks.

Cattle breeding in a country that has one-third of the world's cattle concentrated on about one-fortieth of the habitable area of the globe may seem like carrying coals to New Castle. But it is not. The cattle of India are not an asset, but a terrible debit to India. The average milk production of an Indian cow is six hundred pounds of milk a year which is not nearly enough to pay for her food and care. This amount of milk provides less than seven ounces of milk a day per person in India. This is the lowest milk consumption of any milk-using civilized people, and about one-fifth of normal requirements India being so largely a vegetarian country, needs more milk as a source of animal protein, than a meat eating people. Again India produces about half the fodder the cattle require for normal growth, so many cattle are condemned from birth to a life of semi-starvation that prevents them from returning to society either milk or work to pay for their keep. The large surplus of inefficient cattle are one of the greatest contributions to India's poverty. So the Institute is tackling with encouraging results, the production of an Indian cow that will pay her

way. We are demonstrating that low producing cows produce dear milk while high producing cows produce cheap milk. Our herd produces five or six times as much milk for each rupee spent in feed and care as the Indian village cow.

The Agricultural Engineering Department after twenty years of experimentation and trial has produced a set of farm implements within the financial ability of the village farmer that can be pulled by his own oxen, that if used all over the United Provinces would greatly increase crop yields.

The climate of the United Provinces is such, and the farm implements so crude that the village farmer could cultivate his land only when climatic factors were most favourable. This led to a system of clean cultivation during the rains, which left the fields in such a state as permitted the maximum loss by erosion. A conservative estimate would be an annual loss by erosion of not less than two billion dollars. The farm implements worked out by the Institute if used in a proper manner at the right time call for a change in soil management that would prevent most of this loss by erosion, and have a cumulative effect in increasing yields. The Engineering Department is proving that labour saving machinery creates employment. Also that poverty is in direct proportion to the amount of hand labour used.

The Agronomy Department has done valuable work in soil conservation. The farm has proved that scientific farming pays in India. With the use of the best we know, the land is producing more than ten times what it was, when we took possession thirty years ago. Several hundred casual village labourers who used to work for about two months a year are now steadly employed for the whole year with an annual money income at least ten-fold. Because there has been an increase in the production of the land, there has been a great increase in the number of people employed on the land, with an improvement in the standard of living of the people so employed.

The Horticulture Department is teaching how to grow fruits and vegetables. India consumes very little of these. If her people consumed reasonable amounts of them thirty percent of India's disease would disappear.

Over a million and a quarter dollars has been contributed by America for the Institute in thirty years. For the last ten years the Government in India has been contributing to the maintenance of the Institute. The Institute therefore is under obligation to show that it has been a faithful steward, using the resources to forward the objects for which they were given. In a way this report is an account of our stewardship of those Americans and Indians who have put their lives into this enterprise. One of my greatest pleasures is to show visitors round, and to explain what the Institute is doing. Many exclaim at the many-sidedness of the work at the splendid team work of staff and students to have the place so full of life. I, too, see all of this and thank God for all that He hath wrought here. But I also am oppressed by the things I do not see. I do not see a Chapel, or an Assembly Hall, or a Library Building, or an Administration Building, or a Swimming Tank, or adequate dormitory accommodation for our students, or bungalows for our staff, or adequate laboratory buildings or equipment, or adequate quarters for the Woman's Home-making Department.

But I have faith to believe God will give all these things which will help so much to bring His Glorious Kingdom to the Indian villages.

SAM HIGGINBOTTOM.

THE ELEVENTH COMMANDMENT

"Thou shall inherit the holy earth as a faithful steward, conserving its resources and productivity from generation to generation. Thou shalt safeguard thy fields from soil erosion, the living waters from drying up, thy forests from desolation, and protect thy hills from overgrazing by thy herds, so that thy descendants may have abundance forever. If any shall fail in this stewardship of the land, thy fruitful fields shall become sterile stony ground and wasting gullies, and thy descendants shall decrease and live in poverty or be destroyed from off the face of the earth."

W. C. Lowdermilk, Chief of Research, Soil Conversation Service, U.S.A., in an article published in "American Forests."

REPORT
OF THE DEPARTMENT OF HORTICULTURE

By

W. B. Hayes

Horticulturist

Most of the activities of the Department of Horticulture have experimental, commercial and educational aspects. The aim of this report is to indicate the problems which have been investigated, mostly rather superficially, in recent years, and some of the information which has been gained. Many investigations are being continued, some of them at intervals when the limited staff is able to find a little time to work on them along with more pressing tasks. This is therefore very largely a progress report.

A variety orchard was started in 1932, with the double object of finding out what species and varieties of fruits were adapted to local conditions, and of making it possible for students to become familiar with many different fruits. It was recognized that there was very little chance of some of these proving successful, or even remaining long alive. Thus we were not surprised that apple and pear trees soon died. Peaches of several varieties did somewhat better, but most of them have now died Only one bore crops of commercial size, and in that case the quality was poor. The peen-to or saucer type of peach is more likely to succeed in this climate, and is now being tried.

Although it is highly desirable to try out a number of fruits which are grown in other countries, this involves considerable difficulty and expense. Most of the trees in this orchard were therefore secured in this country. Among the more recent additions, however, are seven of the newer varieties of tangelo, secured from the United States Department of Agriculture, and three other citrus trees from America (out of six shipped). The planting now includes

one or more varieties of: mango, guava, fig, pummelo, lemon, lime, Indian types of citrus not classified, grapefruit, sweet orange, mandarine, sweet lime, kumquat, bael, pomegranate, jackfruit, monkey jack, *aonla* (Phyllanthus emblica), P. distichus, jujube, *jaman* (Eugenia jambolana), sapodilla, *khirni* (Mimusops hexandra), rose apple, carambola, *panyala* (Flacourtia cataphracta), F. ramontchi, wampi, and tung oil.

The fig trees in the variety orchard are of several varieties, secured from the Government Gardens, Saharanpur, and have grown very vigorously. In spite of heavy flowering, they have produced very few edible fruits. Most of the receptacles remain on the tree for a long time, but do not develop properly. Some years ago cuttings were secured from Poona which grew into trees which behaved in the same way. At both Saharanpur and Poona these same varieties are said to produce satisfactorily. The cause of the failure at Allahabad remains obscure.

In addition to the grapefruit in the variety orchard, 24 trees each of the Duncan, Excellsior, and Marsh varieties were received from Florida in 1932, and planted in an orchard along with certain seedling trees grown here, part of which were grapefruit. The Florida trees are on rough lemon rootstock, and grew very satisfactorily. A few fruits were borne in 1934 and more each year until 1941. In the early years, the fruit was large and rather course, with some tendency to granulation, but as the trees matured and bore heavier crops, smaller fruit with thinner smoother rinds was produced, and granulation became less common. The flavour of the fruit compares very favourably with that produced elsewhere.

Disease has been a serious problem with the grapefruit from the first. The earliest to become serious was canker. Some of the first fruits were badly marked, but as the trees became larger and more of the fruit was borne on the inside of the tree, it was noticed that the inside fruit was seldom affected, although some damage to the leaves has continued. Collecting and burning the fallen leaves, and spraying the new growth with a 5-5-50 Bordeaux mixture has probably

helped to decrease the disease, although the spraying would doubtless be more effective if it were not for the heavy rains which occur at the season when the disease is most active

Gummosis has proved a much more serious problem. Excising the diseased portion of the bark and treating the wounds with Bordeaux paste or creosote has not always controlled the infection, and several trees have died, and others have become unproductive. Recently efforts have been made to salvage these sick trees by inarching seedlings into the trunks above the wounds Repeated efforts to make cultures of the causal organism have been made by the Plant Pathologist, with entirely negative results. It is therefore impossible to say what the organism is. Sweet oranges and other species budded on *khatta nimbu* (C. karna) have also been attacked, but thus far the seedling trees have been free of this disease.

Of the three varieties, Duncan and Excellsior are so similar that it has proved impossible to recognize them either from the appearance of the tree or from the fruit. The Marsh trees were a little slower in growth, came into bearing a little later, and have produced somewhat less fruits. They have the advantage of being comparatively seedless.

The seedling grapefruit trees which were also planted in 1932 are from seed of unknown origin ; apparently from some pink variety, as all the fruit produced has been pink-fleshed, and many have a pink blush on the rind. They are of good quality. Most of the trees have made excellent growth. As is to be expected of seedlings, the trees are comparatively tall and thorny, and have been slow in coming into bearing. The first fruits were borne in 1938, and a few trees have not yet produced any fruit.

The seedlings were supposed to be grapefruit and santara, but the majority turned out to be *attani* (C. rugulosa), and some to be sweet orange. This was probably due to an interchange of seed by the gardener. The *attani* fruits are juicy and of a pleasant sub-acid flavour, but are in little demand on the local market. Some of them are now being top-worked to other species.

Mottle-leaf or frenching is fairly prominent on the sweet oranges, both seedling and budded, and appears to a certain extent on other citrus fruits. It resembles closely that caused by a deficiency of zinc in other countries There are certain other symptoms which may be due to deficiencies in other elements not commonly applied as fertilizers. Experiments have been begun with the treatment of trees with such elements as are now available.

In November, 1941, a disease appeared on the seedling trees which threatens to cause much damage. Leaves wilt and die, twigs die back, and gum oozes from the leaf scars. At the time of writing the cause has not been discovered, and it remains to be seen how severe the damage will be.

While *khatta nimbu* is a fairly satisfactory rootstock in this area, it is not improbable that other species will prove better for some types of citrus fruits, or for some soil conditions. An extensive rootstock trial is highly desirable, but is a rather large project. Only preliminary trials have been attempted thus far. It is of interest to report, however, that a number of sweet orange trees secured from the North-West Frontier Province, budded on sour orange, have been decidedly dwarfed and unhealthy, and have produced practically no fruit in seven years. This rootstock, while highly successful in some parts of the world, has proved a failure in certain other parts, and is apparently unsuitable here, at least for the sweet orange.

The papaya is one of the most profitable fruits at the Institute, and this has enabled us to carry on certain simple experiments on a fairly large scale. The sex situation in this fruit is complicated, and about 28 different combinations of staminate, pistillate, and various types of hermaphrodite flowers have been observed here. The desirability of securing a large percentage of pistillate plants has led to many theories regarding the determination and change of sex.

It is commonly believed that more male (pistillate) than female (staminate) seedlings are produced in the dioecious strains. In 1935 two acres of papayas were planted, under different plans. In one acre 664 plants were male

and 695 were female; in the other there were 245 male plants and 220 female. Thus 50·16% of the seedling planted were female, indicating that in this strain at least the sexes are produced in equal numbers.

It has frequently been reported that the more vigorous seedlings are largely male. This view is supported by Cheema and Dani, in Bombay Bulletin No. 162, and by Head in U.P. Bulletin No. 60. In 1935 and again in 1937, note was made of the more vigorous and the less vigorous seedlings at the time of planting, and later of the sex of these plants. The results are as follows :

	Male '35	Male '37	Female '35	Female '37	% Male
Vigorous ...	80	160	73	124	54·9
Less vigorous ...	165	147	147	169	49·7

The difference is so small as probably to be insignificant, and in any case too small to be of use in the field. At the time of flowering the male trees were found to be slightly taller and more slender than the females.

It is sometimes said that seed from different parts of the fruit is predominantly of one sex. In tests in 1937 and 1938, the following results were secured, which fail to substantiate the theory :

	Male '37	Male '38	Female '37	Female '38	% Male
Stem end ...	122	71	128	79	48·2
Blossom end ...	130	82	120	68	52·5
Centre ...	126	73	124	77	49·7

According to another theory, the larger seeds produce male plants and the smaller ones female. In 1937, 125 trees were raised from large seeds and the same number from

small seeds. The large seeds produced 66 male and 59 female plants, and the smaller ones 60 male and 65 female plants. The difference cannot be regarded as significant.

The method of determining the sex of a young papaya tentatively suggested in the report of the Fruit Research Station, Kodur, Madras, for 1936-37, failed to give useful results. In this method a piece of iron is suspended over the plant to be tested by a piece of string. A male plant is supposed to cause a circular motion, and a female plant to make the iron swing like a pandulum.

Many observers have reported that male papaya trees occasionally become female but if this happens it must be so rare that it is of no practical importance. Hermaphrodite trees are frequently barren the first year, and then produce fruit, and this may be the basis of most of these reports. It is also held that if the top of a male tree is cut off, the stem which replaces it will be female. Since 1935 the tops of hundreds of trees have been cut at heights of $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4, and $4\frac{1}{2}$ feet from the ground. In accordance with another suggestion, sap from female trees was injected into 50 cut trees. In no case did a change of sex occur. Injuring and exposing the roots of male trees also failed to produce any change.

Parthenocarpy, the production of seedless fruit without fertilization, is known to occur in the papaya. From 1937 to 1939 a total of 230 pistillate flowers were bagged before opening, to prevent pollination. Of these, 23 fell off in a few days, and only 49, or 21.3 per cent. matured. These were all small, averaging 55 grammes in weight, as compared with pollinated fruit from the same tree averaging 1250 grammes. The pulp was only about one-third as 'thick, and was insipid.

Controlled pollination offers great possibilities in a plant like the papaya, in which seedlings are almost universally used, and which are dioecious. Beginnings have been made. Of the strains grown commercially in India, the dioecious ones are more promising than the hermaphrodites, though if the latter could be made to produce well, they would have

the great advantage of eliminating most of the male trees. It has been seen that seed from dioecious plants produces male and female trees in about equal numbers. Pistillate flowers pollinated by hermaphrodite flowers produced seed which yielded 62 females, 67 hermaphrodites and 1 male while seed from a self pollinated hermaphrodite produced 50 females, 105 hermaphrodites and 5 males.

In order to allow cultivation by animals between the plants, papayas need to be planted about 10 feet apart, but some other spacing may prove more economical. In a preliminary experiment started in 1939, plants were placed 5, 10, and 12½ feet apart. In the first season those placed 5 feet apart produced at the rate of 132,198 pounds per acre, those 10 feet apart 70,490 pounds, and those 12½ feet apart only 53,728 pounds. The average weight per fruit was 1·5, 2·1, and 2·3 pounds. The crowded trees are much less stocky and will not do as well in comparison in the second year.

During recent years, in addition to the local strain of papaya, we have tried the following varieties; Brazil, Solo, Ceylon; Singapore, Madagascar, Honeydew, and French. Solo, Honeydew, and Ceylon are promising.

In his bulletin on the guava published in 1934, Sherrard Smith recommended planting guava trees abour 15 feet apart and pruning them very heavily. This recommendation was, perhaps, based on an experiment reported by Cheema and Deshmukh in Bombay Bulletin No. 148 of 1927. This system at Poona seemed to give promising result, although it is not recommended to the growers In 1934 a small plantation of seedling guavas was made, with half of the trees 15 feet apart and half 25 feet apart. When the more closely planted trees began to crowd, severe annual pruning was begun. Records of yield have been kept, and it is hoped that a preliminary report in some detail can be made soon. Although the trees have not yet attained full size, and those planted 25 feet apart should continue to increase in yield for several years, it is already apparent that the heavily pruned trees are not producing satisfactorily. The fruits are somewhat larger, but even with the much greater number of trees per acre, the yield is much smaller.

This seedling orchard was grown from seed from a specially selected very uniform lot of choice guavas from the market. The trees vary greatly in size and shape, and the fruits in size, shape and quality, as well as the part of the season in which they ripen. This demonstrates clearly the necessity of using vegetative propagation in order to get a uniform crop of guavas.

The custard apple is a fruit of considerable importance in this country, but has been largely neglected. As commonly grown, the plants have many stems which crowd each other. In 1934 a small orchard was planted with ordinary seedling custard apples. From the beginning, one-third of the trees have been kept pruned to a single stem. In 1937 a second section of the orchard was so pruned, while one-third has been left unpruned except for the removal of broken branches. As was to be expected, the unpruned trees are the largest. It proved impossible, in most cases, to secure a tree of good shape by pruning after three years, and this method is certainly not to be recommended. The trees pruned to a single stem bore less fruit in the first years than the unpruned trees, but in 1941 the average yield was about the same. The ultimate advantage or disadvantage of pruning in this way will not be known for several years.

The custard apple does not set very heavy crops of fruit, although plenty of flowers are produced. The blossoming season lasts for several months, but the fruits setting late in the year fail to mature in Allahabad. In Egypt, very satisfactory results have been secured by hand pollination. Investigation here showed that the flowers produced before the rainy season seemed to produce no pollen, so all fell off. In 1938, 100 flowers were hand pollinated, of which 75 set fruit, whereas 100 similar flowers kept as a check produced only 20 fruits. The next year 200 hand pollinated flowers produced 170 fruits, while 200 control flowers resulted in 60 fruits.

Falsa (Grewis asiatica), while a minor crop, is grown on a small scale around Allahabad as well as in other parts of the country. The custom is to prune it to within a few inches of the ground each winter, and in some places, after

pruning the leaves are burned over the stumps. Reports from Lyallpur indicate better yields when the plants are pruned several feet from the ground, and experience here confirms this. Plants pruned 3 or 3½ feet above the ground seem to produce better than those pruned either higher or lower.

The germination of certain seeds with hard coats is slow and uncertain. In an experiment with guava seeds it was found that the untreated seed germinated in 30 to 40 days, and gave 74% germination. Soaking the seed in water for 15 days before planting did not materially affect either the total time required or the percentage. Boiling the seed for three minutes reduced the time to 10 days, but reduced the percentage of germination to 64. The most favourable treatment used was putting the seed in concentrated sulphuric acid for 25 minutes and then rinsing it thoroughly. This led to 85% germination in about 5 days. It has been observed that seeds of *babul* (Acacia arabica) ordinarily do not germinate unless passed through the digestive tract of some animal. In an experiment we found that only 1% of the untreated seed germinated in 98 days, while 78% of that passed through a goat germinated in about 10 days. Soaking the seed for 15 days gave only 10% germination in another 15 days, boiling for a minute gave 51% in 3 days, filing the coat gave 69% in 3 days, and soaking in concentrated sulphuric acid for 45 minutes gave 90% in 2 days.

Horticultural products have been under investigation on a very small scale since 1933. Because of lack of equipment, canning has not been attempted to any extent. Formulae have been worked out for the manufacture of jam, jelly, preserves, marmalade, pickles, chutney, catsup, and squashes, from various local fruits and vegetables. Among the products which have been satisfactorily worked out are jelly made from guava, roselle, guave and roselle, jujube and roselle, tomato, gooseberry, and karonda; marmalade from *khatta nimbu* and oranges; catsup, sauce, and juice from tomatoes; and squash from mango, lime, and lemon. Most of this work has been done from the point of view of a cottage industry rather than that of a factory.

REPORT OF THE DEPARTMENT OF BIOLOGY

BY

EDGAR F. VESTAL, BOTANY AND PLANT PATHOLOGY.
W. K. WESLEY, ENTOMOLOGY AND ZOOLOGY,
T. A. KOSHY, AGRICULTURE.

Under the direction of the Department of Biology a number of activities have been carried on in co-operation with other departments of the Institute. These included surveys of the insects which are pests on the farm crops, insect life cycles under local conditions, testing of insecticides, varietal trials with cereals, use of mercury compounds for the control of seedling diseases of crop plants as well as a study of the diseases which occur on the farm crops, a number of which have been isolated and are now being studied in pure culture in the laboratory.

Oat Varietal Trials.

Oat varietal trials were begun on the Agricultural Institute Farm in 1936 at which time there were 17 varieties on hand. Ten of these had been received from the United States Department of Agriculture, Washington, D. C., and seven were of Indian origin. The 10 varieties from the United States Department of Agriculture consisted of Fulgham, C. I. 708; Nortex, C. I. 382; Burt, C. I. 1961; Brunker, C. I. 2054; Columbia, C. I. 2820; Fulgham, C. I. 3253; Markton, C. I. 2329; Navarro, C. I. 966; Iogold, C. I. 2329 and Gopher, C. I. 2023. From the Institute of Plant Industry at Indore, C. I., we received two varieties, Mulga and Westene, and from the Imperial Institute of Agricultural Research at Pusa we secured four varieties, VII-54, X-27, Hybrid-J and B-52. From the best of the local grown oats a selection was made, and in these experiments will be known as Local.

In 1936 these were all sown in rod rows in the nursery and the growth characters studied. As a result of the observations made most of the varieties were left in the rod rows proving to be too late for this climate and were caught in the hot winds of March. Brunker, C. I. 2054; Columbia, C. I. 2820; and Fulgham, C. I. 3253, of the selections received from the U. S., and Mulga and Westene of the Central India varieties were taken to the field plots in 1937-38. Unfortunately Fulgham, C. I. 3253 was lost from the series during the winter of 1938 by the misplacing of labels. The four mentioned above and Local were planted in randomized layouts for the next three years and yield data secured. The layouts were so planned that the plots were in the form of rectangles and the blocks as nearly square as possible. The location of the layout on the farm was changed somewhat from year to year but the shape and approximate size of plot and blocks remained the same. Table No. I. contains the yield data of the different varieties for the years mentioned.

TABLE No. I.

Yield expressed in pounds of total straw and grain and of thrashed grain of six varieties of oats grown in randomized layouts at Allahabad 1937-38, 1938-39 and 1939-40.

Variety	1937-38		1938 39		1939-40	
	Total	Grain only	Total	Grain only	Total	Grain only
Mulga ...	167·20	114·73	412·75	90·10	437 30	126·70
Local ...	141 35	79·73	432·55	82·35	425·40	163·65
C. I. 2054 ...	133·55	89·26	462·90	82·30	442·80	136·85
Westene ...	175·51	92·30	468·70	61·70	396·80	133·30
C. I. 2820 ...	189·07	66·99	417·55	68·75	463·55	146·00
C. I. 3253 ..	115·52	96·16	...	...	...	...

TABLE NO. II.

Yield expressed in pounds per acre of the varieties of oats shown in Table No. I. grown in randomized layouts at Allahabad. India in 1937-38, 1938-39 and 1939-40.

Variety	1937-38		1938-39		1939-40	
	Total	Grain only	Total	Grain only	Total	Grain only
Mulga ...	10115·60	433·48	6242·84	1362·76	7163·06	2337·41
Local ...	7946·67	301·47	6542·31	1212·21	8773·89	2869·60
C. I. 2054 ...	8079·77	299·70	7001·36	1078·12	9136·08	2296·20
Westene ...	10616·62	349·00	7089 08	933·21	8184·00	2221·68
C. I. 2820 ...	11272·06	252·54	6315·44	1039·84	9560·71	2560·11

The methods used in planting, caring for and harvesting of the plots were the same in all three years. The plots were under irrigation so that they were not dependent upon rainfall. In 1937-38 the plots were on a very rich piece of soil and there was a heavy yield of straw as will be seen by examining the data in Table I and Table No. II. Also the plots were struck by a storm just before thrashing time and some of the grain was lost. The two factors combined to produce a very low yield of grain for that season. Just why there should have been so much greater yield of thrashed grain in 1939-40 than in 1938-39 is not quite clear. The records of temperature and humidity for the two years is nearly the same, with the humidity and temperature of January, February and March of 1940 slightly lower than that of the corresponding months of 1938-39. This may have been partly responsible for the increase (See Table No. IV under Rust observations).

Summary tables in which would be shown the significant differences between varieties will be omitted from this report for the sake of brevity. In place of these, Tables Nos. III and IV will be shown which contain the ranking of

the varieties according to total yield and thrashed grain for the three years in which they were grown in the randomized layouts.

TABLE NO. III.

Comparative ranking according to total yield of oats grown in randomized layouts at Allahabad, 1937-38, 1938-39 and 1939-40.

Year	Westene	C. I. 2054	Local	Mulga	C. I. 2820
1937-38 ...	II	V	IV	III	I
1938-39 ...	I	II	III	IV	IV
1939-40 ...	IV	II	III	V	I

TABLE NO. IV.

Comparative ranking according to thrashed grain of oats grown in randomized layouts at Allahabad, 1937-38, 1938-39 and 1939-40.

Year	Westene	C. I. 2054	Local	Mulga	C. I. 2820
1937-38 ...	II	III	IV	I	V
1938-39 ...	V	III	II	I	IV
1939-40 ...	IV	III	I	V	II

A glance at the data in the two tables will show that some of the varieties are much better for total yield than for thrashed grain. For forage, Westene and C. I. 2820 appear the two best with C. I. 2054 close behind. The word "probably" is used in this case because it is doubtful if three years is sufficient time to establish a variety as the best or worst. For thrashed grain Mulga would appear as the best of the varieties, although in 1939-40 it was in last place and Local was first in yield. These tables are interesting because they show that the varieties are not alike in their reactions to the condition of climate and soil from year to year.

These trials are being continued under the Department of Agronomy and it is hoped that further reports will be made available so that more definite recommendations may be made for this part of India.

Seedling Disease Control.

Because of the high humidity and temperature seedlings suffer from soil diseases during the kharif season more than any other period of the year. On the other hand there are soil borne diseases that are of little importance in the kharif season but are active in the rabi season. The use of mercury compounds for the treatment of seeds is a common practice in the United States and other parts of the world and has been done in India but because of soil and climatic differences it is necessary to conduct trials in each locality to determine the most effective treatments for the particular crop diseases.

In 1936 the Institute secured small lots of four of the most highly recommended mercury compounds from the E. I. Dupont Company, Wilmington, Delaware, U. S. A. These were Semesan, New Improved Semesan Bel, New Improved Semesan Jr. and Granosan. As the samples arrived too late for the kharif season, an experiment was conducted with wheat to test their effect upon germination and yield of that crop. Accordingly a randomized layout was planned and planted, consisting of 20 foot rows, four rows to the plot, five treatments to the block and six blocks (replications) to the layout. Seedling counts and yields were collected and the data analyzed according to the methods of R. A Fisher. The totals for each treatment are included in Table No. I.

Table No. I.

Germination counts and yield in grams of P. 4 wheat treated with mercury compounds and sown in a randomized layout at Allahabad, 1936-37.

Treatment.	Germination Count.	Yield in thrashed grain in grams.
Granosan	2,140	1,956
Check	2,352	2,659
Semesan	2,812	2,121
New Improved Semesan Bel ...	2,656	2,771
New Improved Semesan Jr. ...	2,477	2,727

The analysis of the above data showed a significant difference between any two varieties to be 368·66 for the germination counts and 398·8 for the yield data. When these measures were applied to the data in Table No. I, they showed New Improved Semesan Bel, New Improved Semesan Jr. and Semesan superior to control but only Semesan significantly so.

In 1938 the Imperial Chemicals Ltd. of Calcutta sent us a sample of Agrosan G. a mercury compound which they were distributing, and this was added to the four already mentioned. A layout, similar to the one used in the P. 4 wheat experiment referred to above, was planted using the five mercury compounds mentioned which, with the control, made six treatments. The layout was planted, the seedlings counted and the harvest data collected all under normal conditions and the crop was uniform throughout. Analysis of the data did not show any significance between any of the treatments although all of the treated seed plots gave higher seedling counts and yield than the control.

In 1939-40, a somewhat more extensive experiment was carried out in which jowar was used. The layout consisted of two parts; one planted and harvested for forage and the other for seed. The forage layout was planted at the rate

of 40 pounds per acre and the seed layout at the rate of 10 pounds per acre. Each layout consisted of six blocks of six plots each. Each plot consisted of six row two feet apart and 72 feet long. The rate of mercury compounds was two ounces per bushel of seed, the seed being treated by placing it in a tight container, together with the mercury, and thoroughly shaking it until the seed was well covered with the mercury dust Seedling and survival counts were made. The first when the seedlings were some three inches high and the latter when the crop was ready for the harvest. Table No. II contains the data of the forage layout and Table No III the data of the seed layout.

Table No. II.

Germination and survival counts of jowar treated with five different mercury compounds and planted in a randomized layout at Allahabad, 1939-40.

Treatment.	Germination counts.	Survival counts.	Loss in number.	Loss in per cent.	
Granosan ...	24,520	10,566	13,954	43·09	
Agrosan G. ...	23,494	9,854	13,640	41·94	
New Imp. Semesan Jr.	23,955	10,133	13,822	42·30	Harvested for forage.
Semesan ...	25,660	10,666	14,994	41·56	
Control ...	21,693	9,999	11,694	46·09	
New Imp. Semesan Bel	24,152	10,291	13,861	42·60	

TABLE No. III

Germination and survival counts of jowar treated with five different mercury compounds and sown in a randomized layout at Allahabad, 1939-40

Treatment.	Germination counts.	Survival counts.	Loss in number.	Loss in percent.	
Granosan ...	6,998	4,408	2,590	37·00	Harvested for seed.
Agrosan G. ...	6,563	3,929	2,639	40·14	
New Imp. Semesan Jr.	6,770	4,552	2,218	32·76	
Semesan ...	7,151	4,637	2,512	35·15	
Control ...	6,539	3,849	2,690	41·15	
N. I. S. Bel ...	6,931	4,456	2,475	35·70	

The yield data for each of the layouts was collected at the harvest time and analyzed for significance. The data is included in Table No. IV.

TABLE No. IV.

Yield in pounds of forage and thrashed grain of jowar treated with five different mercury compounds and sown in a randomized layout at Allahabad, 1939-40.

Treatment	Forage section yield.	Seed section yield.	
Granosan	701·5	47·2	There is a significant difference between the yields of Semesan and Granosan and those of the Control in the forage section at a 5 % level.
Agrosan G.	609·9	48·2	
New Imp. Semesan Jr.	643·8	51·3	
Semesan	780·8	62·5	
Control	614·1	47·8	
New Imp. Semesan Bel.	652·2	58·5	

With the exception of Agrosan G in the forage section and Granosan in the seed section all of the treatments gave higher yields than control but, as mentioned above, only Semesan and Granosan in the forage section gave a significantly higher yield.

When the data in Table Nos II and III are examined, it will be seen that there is a serious loss of seedlings from the time of the germination count until the harvest time. It was thought that some of this loss might be avoided if a more correct seed rate for each of the types of cropping were determined. With this in mind a layout was planted in 1940 in which six different seed rates were used. These were 20, 25, 30, 35, 40 and 45 pounds of seed per acre. The layout was the same size and shape, as well as number of units, as each section of the seed treatment experiment just described. Germination and survival counts are included in Table No. V.

Table No. V.

Germination and survival counts of jowar planted in a seed rate randomized layout at Allahabad, 1940.

Treatment.	Germintion counts.	Survival counts.	Loss in number.	Loss in percent.
20 lbs.	15,936	8,639	7,299	45·81
25 „	16,825	8,507	8,318	49·43
30 „	20,675	10,970	9,705	46·45
35 „	22,943	11,479	11,464	49·96
40 „	25,158	11,904	13,844	55·07
45 „	29,048	12,691	16,347	56·27

The loss in percentage of seedlings did not change appreciably until the 40 pound per acre rate was reached indicating that at that point the maximum seed rate for this type of

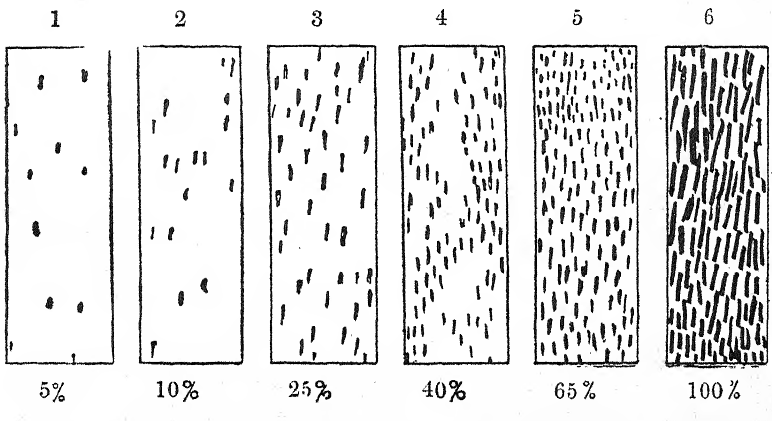
crop had been passed. It appears from this one experiment that the best seed rate for the forage crop might be between 35 and 40 pounds per acre, with 35 being the nearer the correct figure. When the yield data was secured it was found that the 35 pound seed rate gave the highest yield followed very closely by the 30 pound per acre planting. The 40 and 45 pound per acre planting were lowest in total yield of any of the seed rates. The table containing this data is omitted for the sake of brevity.

Rust Observation

Beginning in 1936 varietal trials with wheat varieties have been carried on, on the Institute farm with some changes in the varieties used from year to year, but with the same general type of layout. Reference to the tables of data collected will show the varieties used each year. A part of the data collected each season was the amount of rust appearing on the different varieties. The measure used to determine the amount of rust occuring was that used by the United States Department of Agriculture and shown in Figure No. I.

FIGURE NO. I.

Scale for Estimating Rust



NOTE :—Taken from Cereal Disease Field Notebook C. I. Form 11, U. S. Department of Agriculture.

Thr readings were made in varietal layouts which were being conducted by the Department of Agronomy for varietal trials, but which lent themselves equally well for the rust reading Tables I, II and III are summaries of the data collected on each of rusts common on wheat from 1936 until 1941. The layouts were composed of six blocks consisting of as many plots as there were varieties. The plots were rectangular and consisted of eight or ten rows. The number and length varying from year to year. Rust reading were taken at each end and in the middle of each plot and the three readings averaged for the amount of rust on the variety of that plot. The averages for each plot were added to make up the totals for that year. The figures appearing in each column is the total infection found on the particular variety for that season. In this case the values are in terms of 0 to 6 instead of percentages.

TABLE NO. I

Leaf rust (*Puccinia triticina* Erikss.) infections on varieties of wheat planted in randomized varietal layouts at Allahabad, 1936-'41.

Year	Local	P518	P12	P8A	C13	P52	P54	P4	P111	P165	Date of reading.
1936-37	28·0	16·25	14·0	11·5	7·50	7·00	..	5·5	6·00	..	27-2-37
1937-38	26·75	..	..	7·37	10·12	8·37	10·75	5 73	5·87	0·37	26 2-38
1938-39	31·82	..	..	7·65	11·81	7·63	8·47	12 83	14·14	4·32	8-3-39
1939-40	17·31	..	..		12·36	9·99	8·61	9 72	9·96	5·71	9-3 40
1940-41	22·00	..	..	.	0·50	0·40	..	0·5	0·90	0·10	17-2-41

TABLE No. II

Stripe rust (*Puccinia glumarum* Schm. Erikss.) infections on varieties of wheat planted in randomized varietal layouts at Allahabad, 1936-'41.

Year	Local	P518	P12	P8A	C13	P52	P54	P4	P111	P165	Date of reading
1936-37	No record of stripe rust made										
1937-38	12·10	..	..	0	0	0	1·62	0 2	0	0	26-2-38
1938-39	..	No record made. Rust only a trace.									
1939-40	31·00	..	..	..	4·25	15·00	12·00	0	0	0	9-3-40
1940-41	3·60	..	..	..	..	0·1	0	0	0	0	17-2-41

TABLE No. III

Black stem rust (*Puccinia graminis tritici* Pers. Erikss and Henn.) infections on varities of wheat planted in randomized varietal layouts at Allahabad, 1936-'41.

Year	Local	P518	P12	P8A	C13	P52	P54	P4	P111	P165	Date
1936-37	28 00	16·25	14·00	11·50	7·50	7 00	..	5·50	6·00	..	27-2-37
1937-38	7·98	..	..	2·98	2·24	2·48	6·36	8·15	8·48	3 50	26-2-38
1938-39	29·49	..	..	13·60	14·85	7·65	6·31	13·61	13·35	3·26	8 3-39
1939-40	15·00			..	8·85	4·30	..	10 15	9·07	2·60	9-3-40
1940-41	0·60	..	..	..	0·10	0 50	0·0	0·20	0·10	0 0	17 2-41

In the case of leaf rust, as shown in Table No. I, it will be seen that none of the varities are immune but P165 is highly resistant. There is some variation in the amount of rust occurring on the different varieties from season to season. This was especially true of the years 1939-40 and 1940-41. The amount of rust occurring on Local from 1936 to 1939 was fairly constant, that on the other varieties more variable. In 1939-40 the leaf rust on Local was appreciably less than in the previous three years, whereas

the amounts on the other varitiees was somewhat higher. Although the final readings of 1940-41 were taken somewhat earlier than in 1939-40, leaf rust was more abundant on Local. On other varities it was much less. From the Institute records there would appear to be some relationship between the rainfall and the amounts of rust, especially in the case of black stem rust.

TABLE No. IV

Rainfall, temperature and humidity for the months of December, January, February and March of the Allahabad district for the years 1936 to 1941.

Year	December			January			February			March		
	Mean T.	Mean H.	Tot. rain.	Mean T.	Mean H.	Tot. rain.	Mean T.	Mean H.	Tot. rain.	Mean T.	Mean H.	Tot. rain.
1936-37	64·8	88·3	0·68	55·1	71·2		63·9	80·9	1·53	74 6	45·3	0·15
1937-38	58·7	..	0·0	62·2	91·3	2·40	62·5	..	0·50	79·3	..	0·0
1938-39	58·6	53·7	0·0	60·5	67·7	0·78	66·2	73·0	0·33	72·3	43·2	0·0
1939-40	59·6	61·9	0·0	59·6	63·9	0·10	63·8	63·7	0·51	70·5	53·9	0 60
1940-41	60·9	69 0	2·12	60·7	78·6	1·03	64 6	62·3	0·20	77·9	39·9	0·0

Data compiled by S. C. Bhatnagar.

Table No. IV is a month by month summary of the rainfall, temperature and humidity for the years 1936-41 recorded at the Institute. A study of Tables I and IV does not show much light on the variability of the rust infections during that period. Final readings for the year 1939-40 were taken a day later than those in 1938-39, but the infection was little more than half that of the 1938-39 readings.

The stripe rust infections (Table No. II) are of interest because of the epidemic which occurred in 1939-40. In this case the rust was among the first to appear. It usually does not appear until after the leaf rust has been in the fields for

some days. It usually appears in a mild form and only on the very susceptible varieties. In 1939-40 it appeared on C13, P52 and P54 which are not usually attacked and it was more prevalent on Local than the leaf rust or black stem rust. A study of the rainfall and humidities in Table No. IV does not aid in explaining it

The black stem rust (Table No. III) infections are even more irregular than the leaf rust. 1937-38 was a year of low stem rust infection. The fact that it was normal for leaf rust makes it difficult to explain. Unfortunately the humidities for the months of December, February and March of that year were not recorded. A rainfall of 2·40 inches in January of that year is somewhat unusual and this would be certain to influence the humidity and dew fall. In 1940-41 there was a rainfall of 2·12 inches in December and 1·03 inches in January. In this season the rust infection was very low. This may be only a coincidence but the fact, that in both years in which there was rainfall in January or December, the black stem rust infections were low, may be worth considering. These data are now being considered by the Institute as possible basis for experimental work of the future.

Other Studies on Fungi.

During the past year there have been a number of fungi isolated from diseased plants on the Institute farm. In the fall of 1940 a fungus was isolated from gram (*Cicer arietinum L*) which appeared identical with one named *Operculella padwicki* by Keshwalla, at the Imperial Agricultural Research Institute, New Delhi. Papaya stems were found infected with *Pythium aphanidermatum* Fitz. In 1940 the plantings suffered heavily but this season there does not appear to be much. Experiments with fungicides have been inconclusive because of the small amount of the disease present this year. A *Phyllosticta* has been isolated from the leaves of guara (*Cyamopsis psoraloides* DC) and appears to be generally distributed over the farm and neighbourhood areas. The sponge guard (*Laffa aegyptiaca*

Mill.) was badly attacked by *Colletotrichum legenarium* (Pass.) E. & H. in 1940 but the disease has not reappeared this season on the gourd but it was secured from a culture of Cercospora which was taken from sann hemp. As there are no records of the organism ever having been found on sann hemp before, its occurrence on that host in this instance is of interest. Several other fungi have been isolated and are now being studied in pure culture. Among these is a culture from cow pea (*Vigna catjang* Walp.) of a fungus which produces coremia-like fruiting bodies. These bodies are greenish black, the spores are small, 1·6—4·75 microns in size, oblong-oval in shape.

Recently a disease has appeared among the guava trees in orchards near Allahabad. A few branches at a time show signs of wilting which becomes more evident with time and in a few days the leaves turn brown and wither. Examination of the bark shows it browned, in some cases even into the wood. Later the wood becomes dark. Examination discloses a variety of conditions. In some cases the bark may be still green but the wood at the cambium layer stained dark. In other cases the bark may be dark but the wood normal. So far at least five isolations have yielded a fungus from the wood just beneath the cambium This fungus is white on oatmeal agar with spore-bearing branches somewhat like those of *Verticillium*, although no species of this genus have so far been reported in India. Sections of the wood cut from beneath the cambium and stained with cotton blue showed a fungus in the pitted tracheids that appears identical to the isolations. The cultures are being studied and the progress of the disease in the orchards followed. The fact that this disease is beneath the cambium would mean any control must be preventive in nature.

The effect upon rust incidence of interplanting susceptible and resistant varieties of wheat.

When P4 and Local varieties of wheat were planted alone, in alternate rows one foot apart or mixed in the same row, the amount of rust appearing on the two varieties was found to be affected. The following table gives the results of the rust readings on the two varieties.

TABLE No. I.

Incidence of rust on P4 wheat when planted alone, in alternate rows with Local, or mixed in the same row with Local in a randomized layout at Allahabad, 1939-40.

Rust	Treatment No. 1		Treatment No. 2		Treatment No. 3
	Local	P4	Local	P4	P4
Leaf rust ...	41·50	32·00	37·50	33·50	33·00
Stripe rust ...	75·00	0·0	67·50	0·0	0·0
Black stem rust	30·00	16·0	21·0	14·75	13·0

In Treatment No. 1 the varieties were planted in alternate rows one foot apart. In Treatment No. 2 they were mixed tcgether and planted in the same rows and in Treatment No. 3, P4 was planted alone. There were seven replications. hence the large figures of the total amounts of infection. It will be noticed that there has been some affect upon both varieties in the amount of black stem rust. The amount of leaf rust on Local appears to have been influenced but not that on P4. As P4 is immune to stripe rust, no influence was observed upon it but the infection on Local was slightly reduced when it was mixed with P4 in the same row.

"The whole amount of dissolved and suspended matter brought down by the Mississipi in the course of a year comes to the huge total of five hundred million tons; and it is judged that all the rivers in the world, taken together, discharge some twenty thousand million tons of solids into the sea every year."—*Professor S. J. Shand.*

* * * * *

"I never make the mistake of arguing with people for whose opinions I have no respect."—*Gibbon.*

INSECT COLLECTION, LIFE HISTORIES AND SURVEYS, AND INSECTICIDE TRIALS.

In addition to the collection and classification of insects found in the vicinity of Allahabad, the Entomology and Zoology section has exchanged with other institutions in India as well as the United States. These collections are not only valuable for students but form the basis for further research upon the life cycles under different climatic conditions.

The life histories of a number of farm crop pests have been studied and the cycles recorded under conditions prevailing at Allahabad and some of these have been published from time to time in the Allahabad Farmer. At the same time a number of insecticide formulæ have been tried, their effect under local conditions noted and changes suggested accordingly. Among those tried and found most effective are the following.

Lead arsenate (paste or powder).

Lead arsenate paste	...	$2\frac{1}{2}$ seers.
or		
Lead arsenate powder	...	1 seer.
Gur or molasses	...	3 seers
Lime ...	...	$1\frac{1}{2}$ seers.
Water ...	...	100 gallons.

Effective against caterpillars, sawfly larvae, beetles and their grubs, grasshoppers and their nymphs.

Paris green spray.

Paris green ...	...	$\frac{1}{4}$ seer.
Lime ...	...	$\frac{1}{2}$ seer.
Water ...	...	50 gallons.

Used much the same as the Lead arsenate given above but recommended for caterpillars, orange red pumpkin beetles and grasshopper and locust nymphs.

Paris green powder (First dusting).

Paris green ...	...	1 part.
Ashes, dust or lime	...	8 parts.

For the second dusting use 1 part of Paris green to 32 parts of ashes, dust or lime This insecticide is effective against all insect with chewing mouth parts.

Poison bran mash.

Paris green ...	...	$\frac{1}{2}$ seer.
or		
Lead arsenate	...	$\frac{3}{4}$ seer.
Bran ...	...	$12\frac{1}{2}$ seers.
Gur or molasses	...	$\frac{1}{2}$ seer.
Water ...	...	2 gallons.

Effective against chewing insects like grasshopers, locusts, field crickets, cut worms, etc.

Tobacco decoction.

Tobacco refuse	...	1 seer.
Soap ...	...	$\frac{1}{4}$ seer.
Water ...	...	2 gallons.

This is a stock solution and should be diluted some six to seven times before using as a spray. It is effective against plant lice and similar insects. By reducing or increasing the amounts of the ingredients the formulae may be made up to any quantity desired.

During spare time from teaching a survey of the insect pests of the Institute farm and community has been undertaken and some interesting data obtained A summary of the observations is given below.

Termites (*Micotermes obesus* Ramb.) have been a very serious pest on the farm on maize, sugarcane, juar and fruit trees. The winged forms appear during the monsoon, and, although the nests have been found, efforts to trace them have not been very successful.

Grasshoppers (*Heiroglyphus nigrorepletus* Bol., *H. banian* Fabr., *Acrida exaltata*, *Attractomorpha crenulata* S., *Chrotogonus* spp.) have all been found among the crops of the farm. *Heiroglyphus* spp. is a very serious pest of juar. In some fields during the past few years sections of the juar fields have been so badly damaged that only the mid-ribs of the leaves have remained. In addition to the grasshoppers, katydids (*Microcentrum* spp., *Holochlora albida*, *Conocephalus indicus* Redt, and *Sathrophyllia rugosa*) have all been collected. One species of the Schizodactylidae (*Schizodactylus monstrosus*) has been collected along the banks of the Jumna River. Although no damage has been charged to their activities as yet they are being kept under observation for further study.

Crickets, (*Liogyrllus bimaculatus* De G. and *Gryllodes melanocephalus* Serv.) have been observed to damage the field crops. The mole cricket *Gyrllotalpa africana* Pal. B.) was found chewing roots and stems of plants but was readily controlled by poisons bran mash.

Plant bugs form a large part of the insect population on the farm. *Pyrilla perpusilla* Wlk. and *P. pusana* were noticed in the sugarcane fields. *Nezara viridula* L., *Aspongopusjanus* F. and *Bagradapicta* F. have been found most commonly on vegetables. On phalsa, *Scutellera nobilis* Fabr. has been observed. The red cotton bug, *Dysdercus cingulatus* Fabr. has been found on cotton and okra. *Lygaeus pandurs*, L. *corisa varicornis* F. and the dusky cotton bug, *Oxycarenus Loetus* Kby., have been observed but do not appear as serious pests. On rice the rice bug, *Leptocorisa varicornis* F., was observed to be serious in some plots during recent years.

Mealy bugs have been observed on sugarcane, guava and pomegranate.

A large number of beetles have been observed on the farm crops. *Epilachina dodecastigma* Muls and *E. punctata* F. are regular in their occurrence on brinjal, potato, tomato and *Cucurbita*. *Aulacophors abdominalis* Kust. and *A. foveicollis* Kust. almost equal the lady bird beetles in the

amount of damage done to *Cucurbita* varieties and to grasses. *A. abdominalis* Kust. being the more harmful of the two. Blister beetles, *Zonabris pustulata* T., have been regularly observed on the juar inflorescences and cause some damage to the flower buds of okra and the shoe flower. Species of *Cantharis* have also been observed on the shoe flower.

The fruit fly *Dacus zonatus* Saund, has been noted as a pest and another species of the same genus *Dacus cucurbitae* Cog. has been observed on the fruits of various cucurbits in this area. The mustard saw fly *Athalia proxima* Klug. have been observed as a pest on mustard and other cruciferous crops.

The caterpillars of various moths and butterflies cause damage to the crops year after year. The rice skippers *Parnara mathias* Fabr. and *P. colaca* Mo., have been observed on the rice plants. Their caterpillars are not so harmful as those of *Padraona augias* Linn. *Danais plexippus* Linn. and *D. Chrysippus* Linn. were among the most abundantly found butterflies being found on species of *Calotropis. Danais limniace, Euploea core* Cram., *Melanitis ismene* Cram. *Euthalia garuda* Mo., *Junonia* Spp , *Hypolimnias missipus* Linn., Ergolis *merione Cram.*, were observed. Species of *Junonia* were very common. On grasses *Melanitis* was the caterpillar usually seen. Caterpillars of *Ergolis* was commonly found feeding on the castor bean. Among the caterpillars which have been seen here are *Delias eucharis* Dr., *Catopsilia crocale* Cram., *G. pyranthe* Linn., *Colias croceus* Fourc., *Terias hecabe* Linn., and *Coletias amata* Fabr. Species of *Terias* were found abundantly on *Cruciferae* species. *Catopsilia* was rather rare whereas *Coletis* was noticed year after year. On the citrus plants *Papilio demoleus* Linn. was the most common caterpillar found although *P. aristolochiae* was also present while *Virachola isocrates* Fabr. is occasionally found.

Of the moths, *Agrostis flammatra* Schiff. and *A ypsilon* Rolt. have been observed on gram and pea. *Earias fabia* Stoll. and *E. insulana* Boisd. are common on cotton and bhindi. Occasionally *Achea janata* has been collected from castor plants. On the paddy plants *Schaenobius bipunctifer*

Hamp has been collected in the stems. Cotton leaves have been rolled by *Sylepta derogata* F. although *Platyedar gossypiella* Saund. was the worst pest observed on the American cottons. On brinjal *Leucinodes orbonalis* Guen. has been quite common. Stored potatoes have damaged by *Phthorimea eperculella* Zell. and stored grain has been damaged by *Sitotroga cerealella* Oliv. Cabbage is damaged by *Plutella maculipennis* Curt. and maize and jowar is occasionally damaged by *Amsacta moorei* Butl. *Utethcisa pulchella* Linn. has been observed as a pest on sann hemp

The above is only a preliminary report on the insect pests of the farm crops and it is expected that observation and study will be continued and reports made from time to time so that in the near future the life histories of many of the insects under local climatic conditions will be known and available for the farmer and research worker.

" Turn not in vain regret
To thy fond yesterdays,
But rather forward set
Thy face toward the untrodden ways.

Open thine eyes to see
The good in store for thee—
New love, new thought, new service too
For Him who maketh they life new."

—*F. L. Hoswer.*

* * * * *

There is no country in the world which can claim so large and such a variety of live-stock as India. Out of the total 600 million heads of the world's cattle, India has 180 million. Out of the world's 47 million buffaloes India possesses 34 million, of the 203 million goats of the world India has 53 million and of 649 million world's sheep, India has 45 million.

* * * * *

"Every step mankind has taken has been Spirit led. Every new discovery has been God's revelation of Himself. With every new blaze of light man comes nearer to the central Power over the world."

AGRICULTURAL ENGINEERING DEPARTMENT, 1941.

By

M. Vaugh

The past year has been one of development of existing material more than of expansion. The year found us with designs pretty well prepared and developed so far as our ploughs were concerned. We had three lines, the U. P. for the larger cultivators with larger oxen and for dry weather ploughing, the Wah-Wah for the cultivator who wanted a set of implements to do the maximum number of operations on a small area at the minimum cost and the Shabash for those who wanted a small one-purpose plough which did not require the changing of parts. The general designs were fixed and some progress had been made in working out manufacturing methods though much still remained to be done in perfecting methods and equipment suited to making the ploughs cheaply from the material available.

The implement catalogue, the first issued by the Institute, was printed in loose leaf form late in the previous year. A salesman was employed who first devoted time to getting the catalogue in shape for the printer and then toured the whole of the U. P. except the Kumaon valley, part of it more than once. This has been of great help in getting our implements known particularly by the Agricultural Department officials and workers and also in getting their ideas and reactions to them, for our own information. We now have a much better first hand knowledge of the extent to which the public and officials are acquainted with the problems of introducing better implements, of the public demand for various implements and of the ideas and preconceptions which in some cases interfere with progress in the use of improved implements generally.

The combined effect of Agricultural Department approval and of wider publicity for our implements led to

greatly increased sales. In the year ending on March 31st, 1941, the following implements were sold:

Shabash ploughs	...	...	627
Shabash cultivators	...	...	34
Wah Wah plough sets	...	...	31
Wah Wah cultivators	...	...	35
U. P. Ploughs	...	...	4
Wah Wah Seeders,	...	...	5
Butter churns	...	...	3
Butter workers	...	...	3
Hand rakes	...	...	27
Hand Hoes	...	...	42
Bull nose rings	...	...	24
Latrine borers	...	...	41
Pruning loppers	...	...	1
	Total Items.—		877

During the period from April 1st to Dec. 1, the following items were sold and delivered:—

Wah Wah plough sets	...	...	42
Spare shares and other parts	...	...	424
Shabash ploughs	...	...	483
Shabash cultivators	...	...	5
U. P. Plough No. 1	...	...	1
U. P. No. 2	...	...	4
U.P. Plough spare parts and attachments		...	17
Nagpuri Yokes	...	...	1
Seeding machines	...	...	1
Gardening tools	...	...	25
Butter churns	...	...	3
Butter workers	...	...	2
Parts for built-in stoves, sets	...	...	4
Latrine borers	...	...	12
	Total items —		1024

The problem of manufacture of implements continues to be of very great importance. Modern conditions demand steel implements for the most part instead of cast iron.

In general, the fabrication of steel requires different and in some cases more elaborate equipment than does casting and an entirely different procedure. With large machine tools and power, the fabrication of steel is economical and the greater unit strength allows reduction in weight as compared with cast iron, resulting in lighter implements of equal or greater strength and with other desirable properties. Under present conditions, the installation of large scale, expensive machines is not practicable or desirable. We believe that it is more desirable to have a number of smaller implement factories scattered in various areas where the product can be adapted to local conditions and can be delivered without large expenditure on freight. We therefore are working on the development of manufacturing processes which by the utilisation of comparatively simple machines not requiring large investments, we can get for the manufacture of implements much of the manufacturing economies of large plants. In this, the use of electric welding plays a large part.

Development of new machines has had to be slowed up, partly by lack of staff who could give undivided attention to it. The increase of manufacturing activity has decreased the time which could be given to new development by Mangru Prasad, the head mistry or mechanic. During the last year, C. V. Paul has had to devote most of his time to the class of men being trained for enlistment in the Ordinance Corps under the local authorities. From September his services were requisitioned for the new National or Central Government training center in Allahabad so he is no longer able to give any time to the Institute. No one has been found who can take his place in the workshop.

From July 1st, 1941, M. D. Strong took up full teaching duties but his time has been largely occupied outside of teaching hours, in the better organisation of the teaching in the student workshop and the physics laboratory for which he has prepared lesson sheets which will be available in future years. M. K. Nandy who was an assistant in the Department of Agricultural Engineering in 1939-40, was not re-appointed in July but in the end of August he was recalled to be an assistant to the head of the department in teaching.

and research. In October, J. C. Barpujari resigned to take up an appointment in the agricultural department of Assam, and it was necessary to switch Mr. Nandy to his duties teaching. S. Thoomickian has continued as salesman and has handled much of the correspondence about sales of implements when not on tour.

More or less work has been done on several projects in hand toward the development of new implements and machines. An improved type of rahat or persian wheel is under construction and neerly ready for test, which it is hoped will overcome the most serious faults of the common type. It is being adapted to use with drive from the "bullock gear" also under development. Designs are practically ready for an improved type of small chaff cutter, suitable for use with either a bullock gear or a small engine or motor. Preliminary tests have been made with an improvised model which are encouraging. Information and material has been gathered for work on low lift water lifts for irrigation of the sort needed to lift water from canals, tanks or small streams and swamps for irrigation, where the lift is only a few feet. We have been encouraged by the Agricultural Department of the U. P. to go ahead with all these projects, but are hampered by lack of staff which is capable of directing the mechanics or of mechanics which are capable of working independently with little direction.

The most encouraging development of the last year has been the progress toward starting of a degree course in Agricultural Engineering at the Institute in co-operation with the Allahabad University. Proposals were presented to the University which were approved by the necessary bodies up to the Academic Council which appointed a special committee to study the proposals and make recommendations. This committee has reported favouring the adoption of the proposals and the institution of a degree of Bachelor of Science (Agricultural Engineering). This report will come before the Academic Councils in March, 1942, and it is hoped that arrangements can be made provisionally to admit student in July, 1942 to the course. The U. P. Government have agreed to increase the grant to the Institute to cover part of the cost of this

course and the Institute authorities have agreed to the conditions of the grant and to the opening of classes in July, 1942, provided the University institutes the course. If started in 1942, this will be the first college in Southern Asia to give such a course.

While the Institute has a fair amount of equipment which will be useful in teaching such a course, the number of students which can be admitted will be limited till additional equipment can be secured. For this funds will be necessary and gifts toward the equipping of the Engineering laboratories will be very welcome.

Additional staff will be needed and it is expected that if the course is started and students admitted, two qualified Indian trained engineers and an assistant, probably a B. Sc. Agr. will be needed in 1942 and one or more additional men in 1943. The war demand for engineers may make the securing of this staff a bit difficult.

While some difficulty is being felt in securing sufficient materials of certain classes, on the whole the Institute has fared fairly well about getting needed supplies and no essential work has so far been hampered by lack of engineering stores or tools. The ability to manufacture a variety of things in our own workshop may be of increasing value if the war continues for long.

Things Work Out

Because it rains when we wish it wouldn't,
because men do what they often shouldn't,
because crops fail, and plans go wrong.
some of us grumble the whole day long. But,
somehow, in spite of the care and doubt, it
seems at last that things work out.

So bend to your trouble and meet your care,
for the clouds must break and the sky grow
fair. Let the rain come down, as it must and
will, but keep on working and hoping still,
for in spite of the grumblers who stand about,
somehow, it seems, all things work out.

—*The Royal Neighbour.*

REPORT OF THE DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING

By

James N. Warner, M. Sc.

Head of Department

Personnel

Changes in the personnel of the department during the past year or so include the arrival from America of T. W. Millen, M. Sc., D. V. M., Specialist in Animal Husbandry. Dr. Millen became acquainted with India during five years he spent at the Woodstock School at Landour. Returning to America in 1935 he took an M. Sc. in Agriculture and a D. V. M. (Doctor Veterinary Medicine) at Iowa State College before returning to the Institute in October, 1940. His duties here include those of veterinarian as well as supervisor of the newly established Institute Apiary.

Other changes were as fallows: In September, 1940, Mr. A. Rathore, B. Sc., left his work as Assistant in Animal Husbandry to accept the appointment of Manager, Government Cattle Farm, Patna, Bihar. He was replaced by Mr. Ram Sarup, I.D.D, A.I D I., who left in March, 1941, to become Milk Recording Assistant in the Animal Husbandry Bureau of the Imperial Council of Agricultural Research at New Delhi. Mr. M. A. Samuel, B. Sc., B.A., A.I.D.I., is now Assistant in the department. Mr. C. W. Dover, B. Sc, A. I. D. I., became Assistant Veterinarian in April, 1941. In September, 1940, Mr. H. P. Roy left his post as Sales Supervisor to enter business for himself; he was replaced by Mr. David Yadava.

Milk and Milk Products

The sale of milk and milk products has been steadily increasing during the past year or more. In November this year

the sales of millk was 27,153 lbs., of butter 1,958 lbs., and of dahi 964 lbs. In November a year ago, on the other hand, the sales of these products were 21,410 lbs. of milk, 1,536 lbs. of butter and 932 lbs. of dahi.

The increase in milk sales is due partly to a daily supply of about 125 lbs. to the Naini Central Jail and partly to increased supply to customers in Allahabad. Special effort has been made this year to sell larger quantities of milk to private or household customers. The demand by such customers is quite constant, whereas the demand by school hostels is very irregular because of the many school holidays. Butter sales have increased largely for two reasons. More customers might be mentioned first. Secondly, as the weather cools off in the early part of the winter months it becomes easier to control temperatures in butter manufacture. This year the cooler weather has been a great help to the Dairy Supervisor in learning to operate the new roll-less churn installed during the year. The quality of butter now being produced is unquestionably a factor in increasing our butter sales to both Allahabad and Calcutta. Dahi sales are larger probably because of a larger number of private customers even though the quality has not been quite so good, perhaps, as a year ago.

These larger sales necessitated an increased supply of milk over that available a year ago In November, 1941, the cattle yard furnished 25,050 lbs. of milk and 589 lbs. of cream as compared to 23,398 lbs. and 937 lbs. of milk and cream respectively in November a year ago. Two village milking centres were maintained throughout November this year. They furnished 7,662 lbs. of milk. The previous year, however, with a third centre operating for a part of the month and with feed conditions generally better, 9,117 lbs. were supplied. Finally, cream purchased from local suppliers during the months in question totalled 2,209 lbs. in 1941 and only 889 lbs. in 1940.

The sales of ice cream stops almost completely when the cooler weather begins in October and November. In November last only about 26 lbs. of ice cream were sold on order, whereas in the month ending the middle of last May

the sales were well over 600 lbs. Ice cream sales are generally increasing, however, and the creamery purchased additional equipment during the past year for its manufacture, in order to meet this growing demand. Flavours now available to our customers are vanilla, chocolate, gur-nut and mango. This latter is prepared by use of a Mango Syrup prepared by the Horticulture Department.

Roll-Less Churn

A new type of power churn is being used to an increasing extent in recent years by butter manufacturers in America. Equipment supply houses in that country give it several different names. Some of these are, No-roll, Roll-less and Vane Churn Briefly it is a modified Victor type barrel churn having especially arranged and designed shelves or benches in it to facilitate the working of butter inside the churn without the use of a roller. A more detailed description of this type of churn and some of its advantages over the separate churn and worker or the combined churn and worker units is given in the Allahabad Farmer of September, 1939, page 177.

The department owned an old single roll Victor type churn which needed a new barrel. A new barrel of the roll-less type, capacity 125 lbs of butter, was designed and constructed by the Engineering Department. The double speed churning and working gearing on the old churn was converted to a single speed arrangement giving a churn speed of 24 R.P.M. It is electric driven.

So far as I can learn, 400 lbs. is the smallest capacity of this type of churn that is available for commercial use, at least in the United States The principle of working butter in such a churn involves two kinds of "flow" of the butter during working. The shelves are designed to cause the cream or butter to flow toward either or both ends or toward the middle. There is a tendency for butter granules to lose their identity and fuse with others as this tendency to flow endwise in the churn occurs during its rotation. Secondly, as the butter is picked up by a shelf at the bottom

of the churn during its rotation, carried upward toward the top and allowed to fall back by gravity to the bottom, a spreading action is effected as the butter hits the bottom. As this occurs there is again a tendency for this fusing of the butter granules necessary in the working of butter. In the case of the small unit now used in our dairy there was some doubt whether there would be sufficient flow of either of these two kinds, especially the latter, to bring about proper working. There seems, however, with the little experience we have had so far, to be little basis for this doubt if the churning temperature is properly controlled. The possibility of the acidity of the cream at churning time being of significance is yet to be investigated. The churn does, it seems, offer considerable promise as a power unit for creameries in India.

Heater-Pasteuriser

Through the help of a grant to the Institute by H.E.H. the Nizam of Hyderabad a demonstration heater-pasteuriser was built in the creamery. This unit is in three parts, consisting of a ten gallon pasteuriser, a forty-five gallon hot water tank and space for preparing ghee in a karahi. A common firebox, moveable on a track from one section to another, provides the source of heat. The pasteuriser has its own water supply separate from the hot water tank. Each of these may be heated separately if desired.

This unit has just recently been installed so no report on its operation can be given at this time. It was designed as a compact unit for small village milk plants and will, therefore, be considered in that respect to start with. Other possibilities may suggest themselves as it is put into use.

All India Students' Cattle Judging Contest

Dr. Burch H. Schneider, previously of this department, urged the holding of cattle judging contests for students at the All India Cattle Show which is held annually in New Delhi. This proposal was accepted by the All India Cattle Show Committee and the first contest was held at the time

of the Fourth All India Cattle Show in New Delhi in February 1941. I acted as Superintendent of this contest at the request of the Committee. Nine teams from Agriculture and Veterinary Colleges in India participated.

The team representing the Institute consisted of: 1. Mr. P. N. Mathur (Captain). 2. Mr. T. V. Rama Iyer. 3. Mr. D.K. Joshi. 4. Mr. A.S. Varma. 5. Mr. S.K. Roy.

Scoring was based upon placing of the animals, written reasons for the placing and discipline of the contestants while in the ring. Our team, coached largely by Mr. N. R. Joshi, placed fifth.

Cost of Production Studies

On November first of this year a detailed study of the costs of production and distribution of milk produced in the Institute herd was begun. This study is proposed to give the cost of production by breeds and will extend to the village centres from which milk is purchased. Each item of cost in the distribution of milk and its products in Allahabad by the methods we use will be considered. The proper distribution of joint costs in the handling and processing of milk in the creamery will also be considered and, time permitting, a cost accounts system will be established. Since the study is to continue for only six months, however, it may not be possible to complete all that is proposed. Mr D. K. Joshi, B.Sc., is in charge of this study. One or two short papers on costs, as determined by this study, will be published in the ALLAHABAD FARMER in due time.

Poultry

Our adult flock of White Leghorn fowls was almost completely destroyed by fowl plague during an epidemic in this area this fall. We have a small pen of birds that have recovered from the disease, one of the birds which escaped the infection and also a fine bunch of young fowls which were not exposed. We are purchasing setting eggs from the Etah Poultry Farm to secure new brood and to increase the

size of our present flock. A pen of Rhode Island Reds is to be started also.

We hope that changes in the feeding and watering arrangements will preclude another outbreak of this disease in the flock. No feed or water containers will be exposed to wild birds. We also hope to breed more resistant fowls from those surviving this outbreak

A number of breeding cocks and setting eggs were sold during the year. We offered one Leghorn cock in exchange for two village cocks in an effort to get our extra males into the villages surrounding the Institute. One man took advantage of the offer and others will probably do so as soon as the disease scare has died down.

(T. W. M.)

Sheep

At the suggestion of the late Mr. Bruen, Livestock Expert, Bombay Presidency, Poona, we did not shear our sheep after the monsoon in 1941. We will compare the amount and quality of a full year's growth of wool to that secured previously in two semi annual clips. We have recently secured a Hissardale ram from Hissar. He now is the only ram kept with our breeding ewes We have some fine wooled sheep in our flock and we are making efforts to increase their numbers and their uniformity. We will have a sheep display in the Rural Development Association's enclosure at the Magh Mela.

(T. W. M.)

Goats

In July the Institute secured the entire herds of Jumnapari goats from the Etah Poultry and Goat Farm. As yet the goats belong to the Imperial Council of Agricultural Research, but we hope to acquire their ownership within a few months. Pedigree, milk yield, growth and expense records are being kept. We plan to concentrate the percentage of the brood of the better goats in the herd by line breeding in an attempt to increase the uniformity and quality of milk yield. All kids are removed to a pen separate from the adult goats as

soon as they are dropped. They are fed milk from degchis from the start We now have 27 fine kids which are Institute property. Our aim is to distribute as many of these goats in the surrounding area as possible with the anticipation that the crossing of them with the desi goats will increase the milk yield, size and value of the goats in Allahabad district.

We believe that the maintenance, at the Institute, of a reasonably large herd of these goats, which will permit adequate selection and controlled breeding, is the best way to establish a superior uniform prepotent strain. We have already received many orders for adult goats and kids, but it will be several months before we will be able to release any, except a few which will be taken over by the Rural Development Association.

(T. W. M.)

Bees

The Institute has recently started an Apiary which for some time will of necessity be primarily for research purposes. We have secured three strains of bees, namely, the plains variety of Apis indica caught locally, the hill variety of Apis indica secured in Mussoorie and two colonies of Kashmir bees which the Rural Development Association have kindly secured for us. We are using hives of American style of two sizes. An eight frame Langstroth hive will be used primarily for the hill and Kashmir bees and an 8 frame "Newton" size for the plains bees. We are making experimental plantings of crops which we hope will provide nectar for the bees. In co-operation with the Rural Development Association we are making a study of available nectar and pollen sources in the district. Also all swarms of bees in the area are being sought out. We plan to make biometric studies of the three strains of bees we have. These varieties of bees will also be compared as to honey gathering ability, ease of propagation, and adaptability for commercial honey production on the plains of the United Provinces.

As soon as the opportunity presents itself we plan to make importations of A. mellifica queens. Experiments will

also be carried on relevant to the processing of honey and wax and the economic possibilities of improved methods of handling the giant rock bees A. dorsata and the collection and processing of its honey. We will have a bee display in the Rural Development Association enclosures at the Magh Mela. There will also be a display of bee-keeping at the Institute Farmers' Fair in February, 1942. (T.W.M.)

Artificial Insemination

Several cows and goats have been impregnated by the use of sperm collected with an artificial vagina The first Red Sindhi calf, a heifer, was born on August 16, 1941. The cow was inseminated on November 16, 1940. Unfortunately the calf contracted an infection soon after birth and succumbed.

We find that our Red Sindhi bulls are as a rule slow breeders and that they are poor subjects for sperm collection by means of the artificial vagina. We are training one of our young purebred Red Sindhi bulls and we have one cross-bred Jersey bull which is a very good subject. The Jumnapari bucks are quite satisfactory.

Our work with artificial insemination so far has been mainly for determining the suitability of our animals for such methods of propagation and as practical demonstrations for students of our Animal Husbandry and Indian Dairy Diploma classes.

Demonstrations of the technique have also been given for several visitors who were either sent here to make a special study of this manipulation or were desirous of seeing a practical demonstration after having studied the theory.

(T.W.M.)

Milking Stock

The strength of the Institute milking herd during the financial year of 1940-41, ending on 31 March, 1941, was as follows:—

	Number March 31st, 1940	Disposal during the year. Transferred from female young stock	Sold	Died	Number April 1st, 1941
Red Sindhi ...	37	5	4	3	35
Jersey-Sindhi ..	19	5	...	...	24
Brown Swiss-Sindhi / Brown Swiss-Hariana	11	..	3	..	8
Holstein-Sindhi ...	2	...	...	..	2
¼ Jersey-Sindhi ...	4	5	...	...	9
¼ Holstein-Sindhi ..	7	1	1	...	7
¼ Brown Swiss-Sindhi / ¼ Brown Swiss-Hariana	9	6	1	..	14
Miscellaneous cows ..	14	10	2	...	22
Murrah buffalo ...	25	5	1	1	28
Totals ...	128	37	12	4	149

This herd fulfils four major functions: educational, experimental, extension and commercial. The herd is used in the teaching of animal husbandry and dairying to students of five different classes in the Institute, besides special students. An examiner of a recent practical examination in animal husbandry remarked, "I am surprized at the confidence with which your students handle the animals". This confidence

can only come through close association with a sufficiently large herd.

Our breeding policy might well be reiterated to make clear the major experimental aspect of the herd. Improvement by selection within the Red Sindhi breed has always been our objective. Consequently all our best producing Red Sindhi animals are bred pure. In order, however, to make effective use of the poorer individuals of this breed, we resort to crossbreeding with foreign bulls whenever possible. Crossbreeding as we practice it, thereby, always begins with a handicap, that is the cows are poor producers. Crosses are then bred back to purebred Red Sindhi bulls. None of our crossbred animals, therefore, have more than one half Jersey for foreign parentage.

Livestock problems in rural India must be approached through ecological studies accompanied by economic investigations. We feel that the earlier this is realized the fewer changes there will be in the breeding policies suggested. Pending such studies, it is safer for purposes of cattle improvement, to introduce into a rural area a breed which has characteristics of size, etc., as nearly similar as possible to the desi stock to which it is to be bred, yet at the same time a breed which is capable of yielding a profit over expenditure. With this in view and in collaboration with the United Provinces Government, we have introduced some Red Sindhi bulls into the neighbouring area. To grade up the local buffaloes, Murrah buffalo bulls have also been introduced. Results, so far, are encouraging.

A cattle show for village animals was held at the time of our annual Farmers' Fair. The number of entries in the Murrah grade class has been steadily increasing every year. A milking contest for the village gwalas was also held during the Fair. The purpose of such a contest is to educate the gwalas in the production of clean milk.

The herd does not add considerably to the revenue of the Institute. Keeping in mind, however, the other functions it is expected to perform a major portion of the herd is not only self supporting, but profitable from a commercial point of view.

The following statement shows the performance of those animals which completed their lactations during the year 1940-41.

	Number of lactations completed.	Average yield in lbs.	Days in milk.	Days dry preceding the lactation.	Milking average per day during milking period.	Overall average.*
					lbs.	lbs.
Red Sindhi ...	23	3660·9	306 5	137·6	11·9	8·2
Jersey-Sindhi ...	18	4464·9	301·3	64·5	14·8	12·2
Brown Swiss-Sindhi / Brown Swiss-Hariana	6	5924·4	315·3	80·8	18·7	14·9
¼Holstein-Sindhi ...	6	4071·2	284·8	64·0	14·2	11·6
¼Brown Swiss-Sindhi	8	4040·9	308 3	65·0	13·1	10 8
¼Jersey-Sindhi ...	3	3649·4	293·0	74·0	12·4	9·9
Miscellaneous cows	12	3785·3	310·7	61·0	12·1	10·1
Murrah buffaloes ...	17	4073·2	280·4	139·3	14·5	9·7

*Production per day during milking plus dry period.

93 3400·3 386·2

Below is indicated the trend of milk production of pure-bred Red Sindhi cows in this herd since 1930. The figures represent the average of lactations completed during the respective calendar years.

Year.	1930	1931	1932	1933	1934	1935	1936
Number of lactations completed.	24	20	19	23	24	20	22
Yield in lbs. ...	2147·0	1986·0	2156·6	2256·7	2329·0	2605·0	2521·6
Days in milk ...	291	216	230	235	243	285	283
Days dry preceding the lactation.	170	165	198	185	199	145	203

Year.	1937	1938	1939	1940
Number of lactations completed	24	20	19	25
Yield in lbs	2884·0	3343·0	3441·5	3432·9
Days in milk. ...	287	299	308	294
Days dry preceding the lactation	128	117	113	142

This table shows a progressive increase in the production of our Red Sindhis. To give a more comprehensible picture of this production trend, however, as reflected in the yearly averages, Figure I gives the same information in graphic form. The production of each individual lactation is classified and indicated by a dot. It will be noted that the yearly averages have shifted rapidly upwards, not alone, however, because of some elimination of the poorer animals, but also because animals in the higher production groups are becoming more numerous.

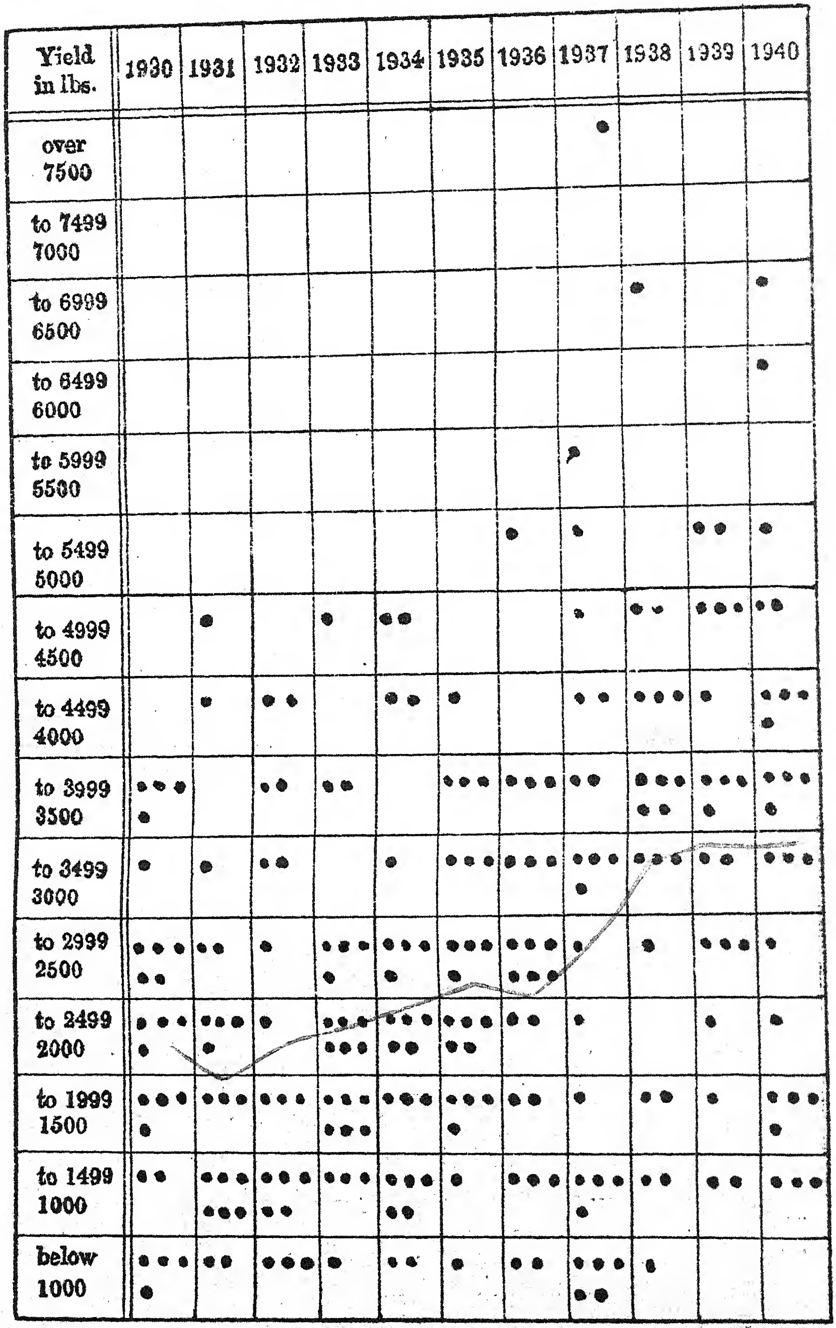

Yield in lbs.
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
over 7500
to 7499 7000
to 6999 6500
to 6499 6000
to 5999 5500
to 5499 5000
to 4999 4500
to 4499 4000
to 3999 3500
to 3499 3000
to 2999 2500
to 2499 2000
to 1999 1500
to 1499 1000
below 1000

FIGURE I

[N. R. J.]

Female Young Stock

The following statement gives the number of female young stock in the herd during the year under report.

	Number March 31st, 1940.	Born during the year.	Disposal during the year. Transferred to milk stock	Sold	Died	Number April 1st, 1941.
Red Sindhi ...	19	15	5	6	1	22
Jersey-Sindhi ...	8	...	5	...	..	3
¼ Jersey-Sindhi ...	16	19	5	2	...	28
¼ Brown Swiss-Sindhi ...	15	3	6	...	...	12
¼ Holstein-Sindhi ...	2	1	1	...	...	2
⅛ Holstein-Sindhi ...	3	7	...	...	...	10
⅛ Jersey-Sindhi ...	3	2	...	...	...	5
⅛ Brown Swiss-Sindhi ...	1	7	...	...	...	8
Miscellaneous cows ...	20	10	10	3	2	15
Murrah buffalo ...	29	9	5	1	1	31
Totals ...	116	73	37	12	4	136

The average age at first calving of 37 heifers in each respective group which, according to the above table, were transferred to milk stock during the year, is as follows :—

Red Sindhi	...	... 2·71 years
Jersey-Sindhi	...	... 2·05 „
¼ Jersey-Sindhi	...	... 2·68 „
¼ Brown Swiss-Sindhi	...	... 2·58 „
Miscellaneous cows	...	... 2·73 „
Murrah buffalo	...	... 3·83 „

16.58

The general health of the female young stock was satisfactory. Modifications in the handling of young calves are being introduced to reduce the death loss even further than what it now is. Data regarding the growth of young animals as indicated by live weight are being maintained. All the animals in the herd are weighed for three consecutive days in a calendar month. The average of these three weights is taken as the live weight for the month. The following table shows the average live weights of Red Sindhi heifers for their first thirty-six months.

Age in months.	Weight in lbs.	Age in months.	Weight in lbs.	Age in months.	Weight in lbs.
Birth ..	42·0				
1	68·3	13	340·2	25	530·1
2	94·9	14	356·3	26	540·8
3	119·5	15	375·9	27	564·5
4	151·9	16	398·8	28	573·5
5	190·7	17	420·1	29	575·7
6	218·9	18	438·1	30	605·1
7	232·2	19	440·7	31	612·0
8	245·7	20	457·8	32	630·0
9	265·4	21	475·3	33	632·7
10	284·1	22	487·1	34	635·5
11	310·6	23	502·9	35	635·7
12	333·4	24	520·3	36	644·2

During the year there were 5 mature Red Sindhi bulls, 6 young Red Sindhi bulls, 3 Murrah buffalo bulls, 1 purebred Jersey bull and 2 crossbred bulls in the herd. The Jersey bull,

Passport's Jap, No. 253799 of the American Jersey Cattle Club, died on September 29th, 1940, at the age of 16 years, 8 months and 25 days. This bull was about 10 months old when it arrived in India early in October, 1924. Three young Red Sindhi bulls are being raised for the Government of Assam.

(N. R. J)

Electric Fencing

In order to maintain proper sanitation of cattle paddocks it is necessary that the land be subjected to occasional cropping. To make it possible to crop and thereby rest that area which we have devoted to use as paddocks for the past several years, we constructed new paddocks nearby in which to keep the animals for two years. What is probably the first electric fencing in India has been installed in making these new paddocks. The fence is constructed with a single barbed wire that is electrically charged with a low voltage current. The animals soon learned that contact with the wire was not a comfortable experience. It has proven a very effective and economical type of fencing.

(N. R. J.)

Nicotiana rustica, one of the two species of tobacco cultivated in this country, is said to have a high content of an acid containing a vitamin which has the property of preventing pellagra, a deficiency disease marked by shrivelled skin, wasted body, and insanity.

It has been estimated that the United States alone needs 200,000 pounds of the above acid, known as the nicotinic acid, for mixing with bread flour, and about 20,000 pounds more for the direct treatment of pellagra.

Nicotiana rustica also contains nicotine which is used in sprays for the control of insect pests.

" What do we ask of life, here or indeed hereafter, but leave to serve, to live, to commune with our fellowmen and with ourselves; and from the lap of earth to look up into the face of God ?"—*Michael Fairless.*

THE FARM

BY

S. R. MISRA

The farm or the Agronomy Department as we call it, is the biggest of the Institute departments in the sense that its activities are spread out over a much larger area. The farm land extending from the sourthern bank of the Jumna river to the Naini Railway Junction, is nearly a square mile. Although it lies in the trans-Jumna tract, it resembles an area in the *Doab*[1]. Soil types vary much from light sandy to heavy clays, including a type of the *Mar*[2] of Bundelkhand.

Soil Reclamation Work

The whole farm area was bought mainly in two big parcels, first in 1911-14, and the other in 1932. The land when bought was eroded and badly cut by ravines and gullies; it was very poor and thickly infested with wild grasses, like *kans*[3], *kus*[4], and *sarpat*[5].

The first step toward soil reclamation was the building up of soil-saving dams at strategical positions on the *nalas*[6] running through the farm which run into the Jumna. These dams help to reduce the rapid flow of water during the rains and the silt-laden water is made to deposit a large part of its silts. Thus the bottoms of the *nalas* have been filled up to 15 feet at its deepest during the course of the last 25 years. Now for many years this part has been the best wheat land on the farm. Our soil-saving dams have also improved the neighbouring village fields. Where the village farmers were not able to grow a crop of barley before, they have now been growing for some years crops of wheat and a mixture of wheat or barley and gram.

1. The alluvial region between the two great rivers, the Ganges and the Jumna. 2. The black cotton soil. 3. Saccharum spontaneum. 4. Eragrostis cynosuroides. 5. Saccharum arundinaceum. 6. Ravine.

The dams were meant mainly for gully erosion. Sheet erosion needed different treatment. The latter is frequently regarded as more dangerous than the former, since the harmful effects of sheet erosion are generally not obvious in its early stages until considerable damage has been done. Sheet erosion eventually leads to gully erosion.

On an area of 300 acres the scheme of broad-base terracing has been adopted for the last two years. The principle of terracing, in short, is to allow the water to flow under controlled conditions. Water erodes or cuts the soil when it has its own way. A terrace is not a *bund*[1], as it is ordinarily understood by people. But it looks like a long, irregular *bund*. Because it is broad-based, it is cultivated and sown to crops, making no difference between the field and its terraces. The water from one drainage area is led by the terraces to an outlet, called flume, which is made firm and is grassed so that it is not cut by big water flow during the rains. The technicalities of terracing cannot be dealt with here. Terraces are very popular especially in the United States of America.

During our short experience of the terracing scheme we have noticed that a field which grew only a poor crop of *bajra*[2] and *arhar*[3] before, grew a good crop of barley and gram last year after it was terraced and without irrigation and any manuring.

In addition to soil-saving dams and broad-base (Mangum) terraces, contour-cultivation is also resorted to. This means that all ploughing, irrigating, and planting operations are conducted across the slope of the fields, and crops sown in lines, the lines following the surface, which is at the same level. Contour-cultivation is necessary for soil improvement, with or without soil-saving dams and broad-base terraces, and ought to be learnt by Indian farmers.

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1 Embankment. 2 Pearl millet (Pennisetum typhoideum). 3 Pigeon pea (Cajanus indicus).

Crops Grown

In addition to the crops grown in this locality several other crops are also grown on the farm. Among the *kharif*[1] crops grown are: *juar*[2], *bajra*, *arhar* (also mixtures of either *juar* and *arhar* or *bajra* and *arhar*), sunn-hemp, *guara*[3], maize, (mung and urd discontinued lately), and a little paddy, soybeans and cowpeas Among the *rabi*[4] crops, wheat, barley, gram, mustard and linseed are grown. Among the vegetable crops are grown: potatoes (both plain and hill varieties), cole crops, brinjal or egg plant, tomato, gourds, pumpkins, chillies, *banda*[5], also a little of a few others such as peas, beans, beets, turnips, etc. Besides these three classes of crops perennial fodders as Napier grass and Guinea grass, other early or seasonal fodder like early bajra fodder, berseem and oats are also grown.

Cropping Scheme

The most potent factors determining our cropping scheme on the farm are: (1) soil fertility, (2) irrigation, (3) a large cattle population and (4) proximity to a big city The part which has been built up to high fertility and is irrigated with the Municipal sewage is cropped 3 to 4 times a year. In certain cases, it comes to 9 crops in two years. The crops commonly grown in this area are *juar* fodder, maize, wheat, potatoes and some other vegetables and early fodders. This part receives frequent clean-cultivation and adequate manuring.

On the other hand the part which is still very poor and is unirrigated (barani) is grown to alternate-season crops This means that a part of this area which is under *kharif* crops one year is followed by *rabi* crops next year and *vice versa*. Crops commonly grown on this area are: *juar*, *bajra*, *arhar*, barley, gram and linseed.

The area intermediate between these two extremes admits of more flexibility. In many cases the fields in this

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1 Autumn harvest. 2 A sorghum or great millet (Andropogon sorghum). 3 Cluster bean (Cyamopsis psoralioides). 4 Spring harvest. 5. Colocasia sp.

area are grown to two crops in the year, that is, they produce both a *kharif* and a *rabi* crop in succession in a year. Some produce only one crop a year, mostly a *rabi* crop like wheat; but it is a good crop.

The maintenance of about 500 heads of cattle, 100 sheep and 150 goats on the farm call for planning for a large supply of fodder. The existence of Allahabad just across the river also causes a special demand for fodders and for vegetable products.

Manures.

All farmyard manure with all farm refuse goes back to the field A large part of the manurial supply is composted with bedding and when decomposed is applied to fields during the seed bed preparation We have compost heaps, not compost pits, on the side of a field in which manuring may be needed. This is generally practised on high-fertility land.

The second treatment of manure is trenching. Wherever a piece of land exists which can be kept fallow for a bit longer, which does not interfere with cropping operations of the adjacent area, and the manure supply is not far off, and it is not urgently required anywhere else on the farm, trenching of manure is practised. Starting from one side of a field a trench 3 feet wide and 1 foot deep is dug with a *pharwa*[1] and the earth is heaped on the border. (Trenches can be made with a scoop-shovel also drawn by a pair of oxen, but the work done is not so uniform as it is with hand work). The trench is filled uniformly with manure 4 to 6 inches deep. (If it is solid manured, the trench should be filled up to not more than 4 inches; if it is mixed with bedding and other farm refuse, then 6 inches). A similar trench is dug next to the first which is then covered by the earth dug out. The trenched manure shows results much longer than the manure applied in any other way.

The third way of treating the fresh manure is to spread it on the field and then plough it in. This is done on the

1. A short handled heavy hoe.

fields which lie fallow for a season, and which would be ploughed even without manuring.

The fourth method of manuring practised on the farm is sheep-folding. Besides our own flock of sheep going round regularly on the farm for grazing, outside shepherds with their flocks are invited at times, who fold them at night in fields systematically. For a flock of 300 the shepherds are paid about one anna and a half a night and free grazing.

The fourth is green-manuring with sunn-hemp which is dealt with in the following section.

Lastly, the inorganic and organic fertilizers also find a place, especially oilcakes for vegetable crops.

Field Practices.

Practices of preparation of land and of growing crops depend very largely upon the power-driven machines and the bullock-drawn implements used on the farm

Among power-driven machinery the farm uses tractor, thresher, grinder and chaff-cutter. The tractor is used for discing fields during seed bed preparation time, only when work happens to be behind schedule. The thresher is used for threshing wheat, barley and gram This year *juar* and *bajra* heads were also tried and the thresher did quite well. The rest of the grains are threshed by the oxen treading them. The grinder is used for grinding cake and grains for cattle feed and also for breaking coarse-straw so it is fine enough for feeding to cattle and for sale. The power chaff-cutter is used for cutting fodder and filling silos.

Bullock-farming has more immediate scope in the improvement of Indian agriculture than power farming. Consequently more attention has been devoted to bullock-drawn implements. We have been using on the farm implements of foreign manufacture—ploughs, harrows, cultivators, and seed drills, for a long time. Implements which are the product of recent development in our Agricultural Engineering Department—the Wah-Wah plough with different attach-

ments, the Shabash plough, the U. P. plough with three different bottoms, the seed drill and the cultivator, have also been used for some years.

All land after the harvesting of seed, *juar* and *bajra* in December, and the *rabi* crops in April, is immediately ploughed. This dry weather ploughing, has been made possible through the use of the U. P. plough with the long, narrow share (rooter) attachment. Generally two pairs of oxen are required for one plough The land is opened up with big clods and is left in a rough condition. Besides chemical and biological benefit such hot-weather ploughed land conserves organic matter, and catches on the leeside of the clods organic dust and protects against wind-erosion Rain falling on such land is absorbed and retains more moisture.

Last rainy season the monsoon rain in Allahabad was below normal by 35 per cent. In June and July especially it was very poor and was attended with bad breaks throughout ths season. Still *juar* and *bajra* on the poor and unirrigated area of the farm, though poor in comparison with other years, was far better than these crops in the countryside. This fact bears out the advantage of hot weather ploughing; especially its moisture absorbing and moisture-retaining aspect. *Juar* was almost a 90 per cent failure in the local villages, although their soil is not inferior, but in many cases, superior to ours. The only difference was that their fields were not ploughed in the hot weather before the monsoon whereas ours were ploughed.

After the beginning of the monsoon *kharif* crops are sown either broadcast or in lines at the earliest possible time. This is done because further ploughing is very largely eliminated. Generally harrowing alone is sufficient But our experience is leading to the belief that even harrowing may be dispensed with. Last year sunn-hemp broadcast for green manuring just before the rains without any further harrowing did as well as that sown after harrowing

Potatoes and other vegetabies have been planted in long rows and inter-cultivated for many years. This method has resulted in reducing cost of cultivation and increasing the outturn as compared to the country method of planting potatoes in small beds.

This experience is leading to the planting of other crops in rows and inter-cultivating them. Planting of *juar* and *bajra* in this way has been tried on 70 acres. Observation of this leads to the belief that these crops if habitually sown in lines would do better than those broadcast.

Rabi crops are generally sown with seed drills on level ground, and with Wah-Wah seed spouts on very uneven ground. The use of cultivators in preparing the *rabi* seed bed promises good results. It does the same work in this case, which the *desi* plough does, but the bullock-cultivator does four times as much with no additional labourer and bullock.

Among our draught stock, we have some cross bred bullocks and also big Hissar bullocks, but many of the oxen are small, bought from the local cattle fair at Rs 50 to Rs. 90 a pair. In the field these small bullocks have done as well as the big ones Proper care and feeding of the oxen is the main thing ; their size under local conditions does not matter so much. Lack of field work for the bullocks in other than planting seasons is the main cause for their neglect in the countryside. The use of more suitable implements will lengthen the working year of the oxen and thus remedy this neglect and will increase the earning power of both the farmer and his bullocks.

Utilization and Disposition of Crops

The annual requirement of roughage to feed all bullocks and dairy and dry cattle is about 2600 tons. About two-thirds of this amount is turned into silage and one-third is fed fresh or as hay. This one-third comprises of soiling fodders, grasses, edible weeds, rogued plants, and green vines and leaves. All seven silos having capacities varying from 100 tons to 200 tons are completely filled in September and October. Some of the silos when emptied partly or completely, are refilled after the juar and bajra seed has been harvested and also during the summer. Some crop husk is used to feed the dry stock, but it is mostly used as cattle bedding. Any surplus fodder, green or dry, all straw, especially of wheat, barley and gram, and vegetables are sold in the city.

All grain is first reserved for seed to the amount which is required, for the farm. What is left of barley and gram

and part of some other grains are kept for bullock feed. After meeting these requirements the surlpus grain is either sold gradually to the farm people for eating or sold in bigger lots in the market A large part of I. P. 4 wheat grown here is sold to the neighbouring farmers as seed and also sometimes sold in hundreds of *maunds* (82 lbs.) to the Government Department of Agriculture for distribution as seed to cultivators.

Rooted slips of Napier grass which is the highest yielding fodder we know of and which is relished by cattle, continue to be sold to Government farms, estate holders, *zamindars* and small cultivators, for many years.

Field Accounting

All crops cultivated well, look beautiful. All other farming activities properly planned and carried on and well spoken of, also look and sound well. But we do not stop with good looks. These should be carried on to the economic test. This economic or business test is the final test of all agricultural operations, recommendations, and improvement of varieties and field practices.

The medium for carrying out the business test is the field or crop accounting. This accounting may be simple financial accounting, enterprise accounting, or complete cost accounting. The last one pays full attention to the details and gives a complete picture of the farming business This accounting is not like the ordinary book-keeping. Farm cost accounting is not so mechanical as the latter, but entails intelligent appraisals and reasonably accurate estimates.

The Institute farm carries on farm cost accounting also. Its system and experience of accounting is ready for publication and is expected to be out before long. It is true that the Institue being essentially an educational institution, all the farm activities are not guided solely by commercial ends. Still the farm in spite of its educational and experimental requirements, unfavourable soil, lack of irrigation facilities and other difficulties, has been paying, although not very highly. But agriculture is a conservative business; it is rarely attended with the sudden fortune or abrupt bankruptcy of the purely commercial or speculative enterprises.

HOME-MAKING DEPARTMENT, ALLAHABAD AGRICULTURAL INSTITUTE

By

Dr. Ethel Cody Higginbottom

On July 7th, 1941, the Home-Making Department of the Allahabad Agricultural Institute opened for its sixth year of work. This Department was inaugurated in 1936 in response to a deep-felt need for more capable wives, mothers, social workers and teachers of Domestic Science and Home Economics. It has been recognized by Government as a training centre for English Teacher Certificate students, so that girls, in addition to receiving instruction and practice in home-making may also prepare to teach it in schools. A syllabus has been drawn up and passed by the Institute staff covering an Intermediate course in Home Economics. This will also give an opportunity to the girls to continue for a B. Sc. in the same field. The University has drawn up two courses for its two years leading to B. A. and B Sc. degrees.

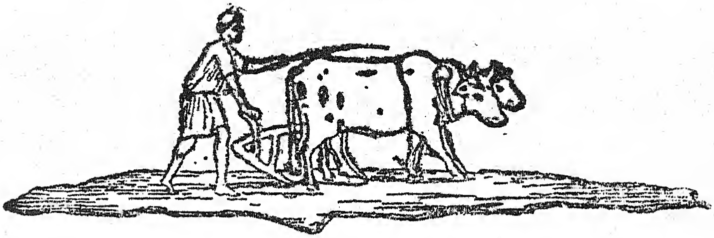
A short course in Home-Making was offered this year from October 13 to December 6, 1941. Two girls from Almora took the course which was given in English.

This year there are 11 girls in the first year and 7 girls in the second year Home-Making class

Mrs. E. F. Vestal was in charge of the department till December, 1941. She has now left for America on furlough and the department is in charge of Dr. (Mrs.) Sam Higginbottom. On its staff are two full-time lady teachers (Miss Ellen Singh, a B. A, D. T., from Isabella Thoburn College, an Indian lady in charge of the teacher training work, and Miss Hoffman, American M. Sc, from Drexel Institute, Home Economics). Other members of the Institute staff and wives of the staff contribute part-time services to teaching in the department.

The corner-stone of the new Campbell Memorial Girls' Hostel, (opposite the present girls' hostel) was unveiled by Lady Hallett, the wife of the Governor, U.P., on November 20, 1941, when there were over 500 people present to witness the ceremony. It is hoped that the Home-Making Department will grow and that the enrolment in July 1942, will be larger.

THE ALLAHABAD FARMER



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FARM COST ACCOUNTS IN THE AGRICULTURAL INSTITUTE, ALLAHABAD,

BY

S. R. MISRA, B.A., DIP. AGR.

Department of Agronomy.

INTRODUCTORY STATEMENT.

Situation :

The Allahabad Agricultural Institute farm is situated in the Allahabad district, *tahsil** Karchana, and *pargana*† Arail. *Tahsil* Karchana and *pargana* Arail are con-

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*A district in British India is really the fundamental administrative unit and is under the charge of a District Officer who is designated as Collector and Magistrate, especially in the Province of Agra. The District Officer is regarded in his Land Revenue capacity as the Collector. For revenue purposes a district is divided into sub-divisions, each of which is a convenient local revenue charge. This charge is called a *tahsil* (place of collecting) and is under the charge of a *Tahsildar* who is responsible for collection of revenue and also exercises judicial powers.

†*Tahsils* are divided into or are conterminous with *parganas.*

terminous. The farm is bounded on the north by the Jumna, on the east and south by the main E.I.R. line, and on the west roughly by an unmetalled road branching from the *pucca* Jubbulpore road and leading to the Naini Junction. It is almost triangular in shape, the apex being towards Naini. It is closely connected with the Allahabad city by the Jumna bridge. The *pucca* Jubbulpore road which is now a cement road for about three miles from the Jumna bridge passes through the north end of the farm and on either side of this road all of the Institute buildings are located.

The Allahabad district is one of the southernmost district of the United Provinces, and lies between the parallels of 24°47' and 25°47' north latitude and of 81°9' and 82°21' east longitude. The extreme length from east to west is 74 miles and the greatest breadth some 64 miles from north to south. The city of Allahabad lies approximately in 25°25'N and 81°50'E., at a height of 340 feet above sea level and at a distance of 564 miles from Calcutta and 844 miles from Bombay [5]. Its population is about 245,000, now and is the capital of the United Provinces.

Topography: – [5]

The Ganges and the Jumna, which unite at Allahabad, divide the district into three distinct parts, which differ materially from one another in their general appearance and physical features. The tract between the two rivers, commonly known as the *doab*, comprises three tahsils. The trans-Ganges or *Gangapar* tract includes three tahsils; while the trans-Jumna country, known as *Jumnapar*, consists now of two *tahsils*, Bara having been amalgamated with Karchana *tahsil*.

The Doab:—

The *doab* is a roughly triangular block of country with an area of about 817 square miles. Both on its northern and southern boundaries it is broken by ravine and is very poor at places and quite rich at others. The western part

of the *doab* is covered in many places with *dhak** and scrub jungle, where *usar* (alkali) plains are frequently to be seen and small *jhils* (ponds) and tanks are numerous. The interior part is mostly quite fertile. The clay belts in the middle and the south at many places resemble the *mar* (black cotton soil) of Bundelkhand. As a whole the *doab* presents the appearance of a rich and fertile country. It is remarkably well wooded and the number of mango and *mahua*† trees is still the chief feature of the country. [5]

Gangapar:—

The area of this tract is about 854 square miles. Its southern edge is formed by the Ganges where in place broad strips of rich *kachhar* (annually inundated lands) are to be seen. Towards the interior there comes a stretch of light loam, to the north of which is a broad expanse of clay extending to the district boundary. Water is here close to the surface and the drainage water collects in numerous *jhils*. This clay belt is very rich. Rice is the main staple, but large quantities of wheat and sugarcane are also produced. [5]

Jumnapar:—

The third and the largest tract is *Jumnapar*, which is entirely different from the rest of the district. It covers an area of 1182 square miles and geographically belongs to Bundelkhand or Mirzapur. In some respects the Karchana tahsil of this tract resembles the *doab* in both its crops and its soils, being an upland plain of loam and clay, with the usual belt of light and indifferent soil along the banks of the Ganges, the Jumna, and the Tons. On its western side, however, the *doab* soils are replaced by a mixture of clay and the *mar* of Bundelkhand. This leads to a low range of hills which form an irregular outwork of the Vindhyan system. South of the Tons in the Meja tahsil there is a fairly rich plain of alluvium in the east, which resembles the adjacent parts of Karchana. The Vindhyan hills run from

*Butea frondosa. †Bassia latifolia.

the Mirzapur border to the western boundary; and from their crest northwards as far as the Belan there extends a plateau of inferior *mar* and clay soils. The general features of this part are rocky outcrops, scanty population, precarious agriculture, and the existence of much waste. ([5])

The Institute area differs from the rest of the *Jumnapar* tract and rather resembles an ordinary pargana of the *doab.* It is said that in the past the Jumna was flowing farther southwards through the middle of the present farm area. Physical signs seem to prove the truth of the above statement. All of the area is alluvial, but was in a very bad physical condition when its possession was obtained in about 1912. It was badly broken by ravines and badly infested with *kans** and *kus*† grasses. The soil was at its minimum productive capacity. Soil reclamation work had to be started from the very beginning. The first soil reclamation enterprise was the putting up of soil-saving dams at strategical positions, which have worked wonders during the last 25 years. Later, this work was followed by strong grassed bunding. Recently broad-base terraces or contours have been laid out on a large scale and their effect is becoming visible even now.

Kans and *kus* are still a common sight during the rainy season, but they are now no longer a serious interference with the usual cultivation.

There is a long depression through the middle of the farm, which used to be a deep *nala* before. This has now been filled up 15 feet at its deepest by drains so that it now looks like low flat depression which works as the main drainage outlet for the farm.

The farm area comprises about 500 acres. A variety of soils are met with. Proper soil classification has not been resorted to but broadly it can be described as below. The poorest are the fine sandy soils strewn with *kankar* (soils incrustations usually of calcium carbonate). The greater area is of light sandy loam which is in the process of being built up in fertility. The depressions have silt

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*Saccharum spontaneum. †Eragrostis cynosuroides.

loam. Most of the good land is light loam rich in organic matter and at places there are heavy loams. Not an insignificant area consists of the tenacious black clay representative of the black cotton soil brought in by Jumna flood.

Climate:— (5)

The climate of the district is characterised by a delightful cold season, a long and almost intolerably hot summer, and a rainy season which at its commencement is quite pleasant. From November to March the weather is pleasant; but about the middle of March the thermometer rises rapidly until in May and the first half of June, Allahabad becomes one of the hottest places in the United Provinces, if not in India. From November to the beginning of the rains the atmosphere is extremely dry until at the burst of the monsoon, the temperature immediately drops by 10° or 15° and varies but little during the next three months. About Christmas there is usually a little rain; and during the hottest parts of the year there are not unfrequently dust-storms and thunder-showers

A Government observatory has been maintained at Allahabad since 1870. The mean barometrical pressure for a period of 22 years in 29·479 inches, ranging from 29·753 in December to 29·205 in June and July. The mean recorded temperature for 30 years is 77·8°, varying from 60·6° in January to 92·4° in May. The highest maximum recorded is 119·8° registered on the 19th of June, 1878, but a maximum of 113° or 114° is reached almost every year at the end of May or the beginning of June. The extreme range of temperature is astonishingly great, amounting on an average to 75·3°, the average maximum in the year being 114 9° and the minimum 39·6°. However, records show as low temperatures as 22° in December, 1913, and 18° in February, 1905.

Rainfall:— (5)

Records of the rainfall for Allahabad and each of the tahsil headquarters are extant from 1864 onwards. The average annual rainfall for 44 years amount to 37·54 inches for the whole district. For Allahabad it has been 39·06 inches. The rainfall for the Karchana tahsil has been

higher than other tahsils. This fact illustrates the influence of the southern hills and forests and also of the principal rivers. This tahsil comes within the scope of both of the storms which follow the course of the rivers and those which sweep over the Vindhyan hills.

Rainfall is generally regular, although unusually wet and dry years have not been rare. About 88 per cent. of the average annual rainfall is received during the monsoon period from June to September. Agriculturally the distribution of rainfall is much more important than its total amount either in the year or in a season. The record of rainfall for the Institute farm has been kept for about 17 years. For the first few years the data are not complete. From 1928 the rainfall records are reliable. These rainfall records for the last 13 years provide an interesting study. Out of 12 years, that is from 1928 to 1939, the amounts of annual rainfall show rather distinct divisions. For 4 years they have been below the average, for 4 years about the average, and for 4 years above the average. In addition to this, there is also detectable a rough succession of like years The year 1928 started with rainfall below the average and the years 1932, '33 and '34 are alike. The year 1929 started with the average amount of rainfall and the years 1930, '31 and '37 are alike. The year 1935 started with rainfall above the average, and the years 1936, '38 and '39 are alike. The highest rainfall recorded during these years was in 1939 (51·64). The thirteenth year, that is, the year 1940 again gave a rainfall below the average. The year 1941 also has turned out to be a year of poor rainfall. The above rainfall records do seem to indicate a cyclic change or order of 12 years. However, this is only an inference and may not stand statistical study.

Agriculture:—

The great diversity in the physical characteristics of the various tracts which comprise the district is reflected in their agricultural development. The average cultivated area for the whole district seems to be about 58 per cent. For the favoured tahsils it is around 65 per cent. whereas the sourthen part of the trans-Jumna tract may

not have more than 48 per cent. Somewhere about 25 per cent. is classed as culturable waste and about 18 per cent. as waste. Of the cultivated area more than two-thirds is unirrigated. About one-fifth of the area under the plough is double-cropped.

The area sown for the *kharif* or autumn and for the *rabi* or spring harvest vary from year to year according to the nature of the season. In favourable years when the rainfall is advantageous for both harvests, the *rabi* area is likely to be the larger. Taking the three main tracts we find that in the *doab* the *rabi* and in *Gangapar* the *kharif* predominates, while in *Jumnapar* the *rabi* is most important to the north of the Tons and the *kharif* south of the Tons.

Karchana tahsil in which the Institute farm is situated, is much more fully developed than the neighbouring tahsils to the south and west. The cultivated area is about 70 per cent. The area bearing two crops in the year averages to about 18 per cent. Save in the loam tract, the means of irrigation are distinctly poor, and the tahsil depends largely on the rainfall. The *kharif* area almost invariably exceeds that of the *rabi*, though sometimes the positions are reversed. Rice is the chief autumn staple, averaging about 40 per cent. of the harvest. Next comes *bajra** alone or mixed with *arhar* † occupying about 30 per cent. and the *juar*‡ and *arhar* with about 18 per cent, while *kodon*§ with 4·4, *sanwan*‖ with 2·92, cotton with 2·42, and sugarcane with 1·87 per cent. make up the bulk of the remainder, small areas being under autumn pulses, hemp, oilseeds, and garden crops. In the *rabi* about 33 per cent. of the area is sown with gram and 24 per cent. with gram and barley (this mixture is called *berra*). Barley by itself takes up 16·51, wheat 8·19, peas 7·83, and wheat mixed with barley or gram 3·69 per cent. There is a considerable amount of linseed and *masur*¶ and some poppy [(5)].

The crops grown on the Institute farm are in general in line with those mentioned above, except that rice is

*Pennisetum typhoideum. † Cajanus indicus. ‡ Andropogon sorghum. § A minor millet (Paspalum scrobicula tum). ‖ A minor millet (Panicum colonum). ¶ A minor pulse, Lentil (Lens esculenta).

not grown here because we do not have proper rice fields. Just a little rice, sugarcane and cotton are grown for educational purposes. With tube-well irrigation more sugar-cane may be grown. We grow more of fodders and vegetables. Minor millets and pulses also are not grown.

People:—

The population of the Karchana tahsil is far more dense than in the rest of the trans-Jumna tract, the rate of 487 per square mile approximating rather to that of the *doab.* Hindus form about 90 per cent. of the population. The cultivation is mainly in the hands of Brahmans, Kurmis, Rajputs, and Ahirs. About 85 per cent. of the inhabitants depend directly on cultivation.

However, in the close proximity of the Institute farm Pasis seem to be in a majority. Muslims are much fewer in number than Hindus, but they are more influential. Most of the farm labourers are Pasis, other castes being Ahirs, Kachhis, Kurmis, and Chamars, and there are some Mohammadans. Mohammadans have much more professional tendencies than the others. Very many of them are job-holders, contractors, *ekka* (a horse cart) or *tonga* drivers, fruit and vegetable sellers and so on. An Ahir is a better worker with cattle than with crops. Kachhis and Koris are probably the best agricultural workers, but they are relatively very few in number as labourers on this farm.

Pasis, on the average, are good agricultural workers. They are, everywhere in the U. P., well known to the police for their extra legal activities. The trans-Jumna tract was well known in the past for organized dacoities which are rare now. However thefts and burglaries are not very unusual. The Institute farm is not immune to thefts of field produce. Nearness to the city is an encouragement for stealing and selling products. The better marketable a field product is, the more subject it is to thieving. Thus the potato, cabbage, cauliflower, pumpkin, melon and banana and other fruit crops suffer in this respect. Thieving of standing crops of fodder and wheat also have not been unknown.

GENERAL STATEMENT ON FARM COST ACCOUNTING

For success in farming the application of the principles of agricultural economics is as necessary as that of the physical and biological sciences. While the latter explain the 'ways' of agricultural practices, the former points the way to 'whats' and 'how much' in agriculture, that is, 'what to produce' and 'how much of each to produce' so as to make farming most profitable under a given set of conditions. The agricultural economist takes up the thread of agricultural investigations at a point where the physicists, chemists and biologists leave it. However, the technical problems and the economic problems cannot be definitely marked off from each other. Most problems have both sides. "Technical studies show what is possible, while economic studies indicate what is expedient." (3)

Farm management and farm records and accounts are important aspects of agricultural economics. Farm accounting is the basis of present day farm management studies. It provides data which form facts. These facts are the truths which cannot be moulded to one's previously held beliefs or desires. They have to be accepted as they stand. No investigation can be properly carried out without obtaining facts based on accurate records. These facts are systematized and analyzed, after which they provide reliable inferences or conclusions to an investigator. Agricultural enterprises require the use and guidance of data just as much as commercial enterprises do. With the development of quick means of transportation over great distances communication, and markets, modern agriculture all over the world has become increasingly industrialized in character, India not excluded. "Bock-keeping is not a direct way of making money, but rather a means of showing where the money goes, of pointing out where profits are being made and where leaks occur. It leads eventually to a better understanding of and insight into the business affairs of the farm, and therefore, as pertinent use is made of the records, to constant improvement and greater profit." (1)

There are now well recognized ways in which required data can be collected for studies in farming. These are farm

accounting and farm business survey. The accounting method may be sub divided into financial accounting, single enterprise accounting and full cost accounting Of course, the first two accounting methods are made use of in surveys also: surveys are conducted by personal interview and questionnaire.

Financial Accounting:—

The financial accounting or farm book-keeping is the keeping of records that will set forth the income, cost, and profit of the farm business as a whole, or a complete unit. It usually presents figures in terms of money only. It shows how the whole farm business stands with the farmer and with others. Detailed accounting with different enterprises is not resorted to in this system of farm book-keeping. That is why it is not attended with the complications of cost accounting. It is rather the aggregate effect of all the enterprises which is sought to be known in financial accounting.

As such, the preparation and formulation of the final financial results of the farm business is comparatively simple and less laborious than cost accounting. For this reason with the same expenditure of time and money accounts can be obtained from a larger number of farms.

Full Cost Accounting:—

Under certain conditions it is advantageous and necessary to know more of the details of farm business, that is, to know how the different enterprises of a complete farming unit stand in relation to one another, what the various operations of an enterprise, *i. e.*, particular crop, fruit orchard, or class of livestock cost. This involves the finding of cost, returns, and profit on production units. Cost accounting furnishes the complete study of the farm business. "Knowledge of cost means fewer mistakes in judgment and better earning ability. Accurate cost data are an invaluable help in analyzing farm accounts to show not only where leaks have reduced profit, but to indicate the paying branches of the industry, thus giving a general guide for planning future development." (1)

Full farm cost accounting is a scientific investigation; it is technical in character and difficult. It involves the outlay of much time and money and close attention to details.

Many items of the cost of production are not actually ascertainable. There seems to be a lack of agreement among writers on cost studies with regard to the inclusion of items of cost, and principles and methods of accounting. In the adjustments of labour, materials, manures, irrigation, etc., to different enterprises, a large degree of estimation is required. There is the difficulty of allocating cost between mixed crops and joint products, for instance, grain crops and their straw, potato and pumpkin, and *juar* (a sorghum) and *arhar* (pigeon pea) or *bajra* (pearl millet) and *arhar* sown together but harvested at different times. There is the difficulty of accurately assessing the effect of one crop on another. Then there is the dovetailing of field operations. Cleaning stubble after the harvest of fodder *juar* is an expense for the *rabi* crop whereas the harvest of potatœs is seed bed preparation for the early fodder crop following it. Some operations may be done in a few minutes before the close of the day after finishing the main operation done that day. Opinions also differ on the inclusion of rent of land and interest on investment in the cost figures. Should both be included or excluded, or one included, the other excluded; if included then on what basis? Many more instances can be annotated, depicting the difficulties of cost accounting. The above points have been mentioned only to show the complicated nature of cost accounting and the difficult problems that a worker in the field has to meet. [3]

As already pointed out, farm cost accounting necessarily introduces estimates. It cannot be absolutely exact. It is based partly on estimates and partly on accurate data and is thus like commercial cost accounting. Ordinary book-keeping is an exact science. If 'A' sells 100 maunds of wheat to 'B' at Rs. 4 per maund* the credit to 'A' and debit to 'B' is exactly Rs. 400. There can be no other answer. Cost accounting is exact only in proportion to the accuracy of the estimates. It is therefore essential to make the estimates as accurate as possible rather than be

*40 seers=82 2/7 lbs.

satisfied with rough approximations. The ability to make accurate estimates comes with study and experience in accounting. However, it is unwise to spend too much time on refinements with cost accounting. There is no significant gain in hunting for very small errors.

In spite of the limitations and difficulties of full cost accounting, it furnishes the most valuable and complete information on farming business. There is no system of accounting which gives such a complete picture of the farm organization and management as cost accounting. It lays open the farm problems which go unheeded and untraced in other systems of farm studies. It serves as a guidance for future farm planning and general agricultural policies.

The report of the conference of representative investigators in farm management and farm economics called by the U.S. Department of Agriculture in 1919, is probably the best of its kind on the purpose and methods of farm cost studies. The relevant portion of the report is quoted here: [1]

"Purpose of Cost of Production Studies :

1. To record the details of the farm business for reference.

2. To give an insight into the elements and inter-relations of the different farm activities.

3. To furnish information that may enable the farmer to reduce costs, or otherwise increase profits.

4. To make possible a comparison of the profitableness of the different enterprises and combinations of enterprises.

5. The records secured by cost of production studies give data for analyzing the farm business, and thus are of fundamental importance in the whole programme of agricultural research and education.

6. From the standpoint of the public, cost of production studies provide the facts which give a basis for intelligent judgment upon the probable effects of any given legislation or other public activity upon the farmer as a producer and as a citizen. Cost of production studies are therefore one of the means of providing the basic facts

needed by legislators and price commissioners in comparing the profits of competing lines of production and estimating necessary values."

The above outline holds as true today as it was in 19 9, and it is as applicable to India as it is to the U.S.A In the Third Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India held at New Delhi in December, 1939, Sardar Kartar Singh in introducing the subject No 4 "A Review of Work on Agricultural Economics in India........" told the same tale regarding the need of farm accounting in India. Full farm cost accounting is of special importance in India since reliable and complete data for proper studies in farm management and organization are sadly lacking.

A word of caution regarding the study of cost of production data is necessary. Hasty conclusions must be avoided. The study of the different items of cost and returns are as important as to know whether or not the particular enterprise pays. Weather conditions, crop conditions, and market conditions should all be considered. Average figures are hardly true guides under all conditions The study of a losing enterprise often gives as valuable information as the study of the paying one. "Sometimes a positive decrease in a year's profit will ensue if an enterprise be dropped, because, taken alone, it has failed to pay." A losing activity may keep the net farm profits from dwindling or may make the net loss less by making better use of labour and equipment than would be possible if the activity were dropped. Ordinarily "any changes if made, should be brought about gradually and the effects noted in their relation to all other farm activities." (1)

Single Enterprise Accounting:—

This system of accounting is similar to full cost accounting except that in this case an account is kept with a single enterprise which is the most important or the major activity of a farm or of an area.

Single enterprise accounting takes much less time than full cost accounting. A larger area can be covered and a

greater number of samples can be studied by this method. The effect of different practices followed in conducting the particular enterprise in an area can also be gauged better. However, where curtailing or increasing the production of a particular enterprise is to be decided upon, the relation of the special enterprise to the farm business as a whole has to be studied.

The Survey Method :—

(a) *Personal Interviews.*—Farm management surveys or farm business analysis surveys in this case are conducted by trained investigators who visit farmers in selected areas, and with blank forms prepared previously, seek by question to draw forth the required data. They are recorded as given, and later tabulated for the deduction or conclusions. It is a comparatively quick, less expensive, and extensive method of collecting farm business data. The number of farms studied should be large so as to give reliable information.

The requisites of the modern survey method of agricultural statistical study are:—(1) the size of the sample included in the study should be large; (2) farms may be selected in various ways, but they should be as representative of the typical conditions obtaining in a particular district or a region as possible. Selection made according to the convenience of accessibility does not give a representative sample; (3) investigators should be well trained and competent to tackle farmers; (4) questions should be well contrived according to the object of the enquiry, and be direct, clear and in orderly sequence; (5) before starting the work farmers should be told the purpose of the enquiry in order to allay their suspicion, and obtain their co-operation. [3].

This method of farm business study has been quite popular in Western countries. As pointed out, the results of the survey studies are based on estimates and answers drawn out from memory and hence do not approach the accuracy obtained in the accounting method. Of course, in Western countries where farmers are generally literate and keep at least simple records, and are not as suspicious of strangers as are Indian farmers, the survey studies are more reliable.

(*b*) *The Questionnaire Method.*—The Questionnaires are sent by mail to the farmers concerned and are answered and returned by them without a personal visit of an investigator. They contain a series of questions and blank spaces for answers, enclosed with a short letter explaining the purpose of the enquiry. Questions should be simple, direct, and clear, mostly requiring short answers only.

This is a quick, cheap, and extensive method of study. Information can be obtained from very widely scattered places. It is useful for "reconnoitering new problems, outlining new research projects and supplementing data secured by other methods." (3)

However, it does not give that detailed and valuable information which is secured through accounting method. There is the difficulty of not obtaining replies from all those to whom the questionnaire is mailed. Where the agricultural population is illiterate, this method is hardly of much use. Individual records vary a great deal but the average results are useful in indicating trends.

The Need of Farm Management Studies in India :—

The ultimate object of the different methods of investigations into the farm business as described above, is the improvement of the general economic condition of the agricultural population. Definite and accurate information is very desirable in planning improvements in any branch of industry. Such accurate information as could be made available by farm accounts is almost entirely lacking in India. The reports and recommendations of various committees and commissions that have been appointed by Government in India from time to time do have their value. They indicate the general trends of economic conditions and suggest general methods for improvement. But they have been far from investigations into the management, organization, and the business side of farming. They do not provide guidance on problems, such as, "what to produce" and "how much of each to produce" under a given set of conditions so as to obtain the greatest continuous profit.

However, besides reports of various committees there has been valuable work in India on village surveys. Sir Theodore Morrison in his inaugural address in 1913 to the Economic Association at Madras, laid great emphasis on the economic surveys of typical villages. Soon afterwards three villages were surveyed by Mr. Chetty and his associates. Dr. H. Mann, Principal of the Agricultural College, Poona, conducted survey of two villages near Poona and published the results under the title "Land and Labour in a Deccan Village" in 1917. This gave impetus to other workers. Information collected from 14 villages by Economics students of Madras University under the guidance of Professor Gilbert Slater was published as statistics of some "South Indian Villages" in 1918. Mr. J. C. Jack, I.C.S., while a Settlement Officer of Faridpur district from 1906 to 1910, made some village studies. The information collected was published in the form of a book in 1916. There have also been some other village survey studies conducted by individuals and institutions like Shantiniketan, the Gokhale Institute of Politics and Economics, and the Servants of India Society. (4)

More important exhaustive studies were carried out by Rao Bahadur P. C. Patil in the Bombay Presidency and the results published in 1933 in "Principles and Practice of Farm Costing with Farm Studies." In the Punjab the Board of Economic Inquiry was constituted in 1919. It has been carrying out systematic surveys of a representative village in each of the 29 districts of the Punjab. Another important series of publications of the Board is that of "Farm Accounts in the Punjab" which is the first attempt of its kind in India to study the economics of farming over a number of years. This work had its origin at the Agricultural College, Lyallpur. (4)

Lately, work of all-India importance has been undertaken by the Imperial Council of Agricultural Research, as (1) a study of the cost of production of crops in the sugarcane and cotton growing districts of India and (2) marketing surveys The first was undertaken in conjunction with the Indian Central Cotton Committee. It involved the heavy

task of accounting 1150 holdings in 144 villages situated in 23 districts of 7 provinces and 3 states Reports of marketing surveys in respect of many important commodities have been published. They give fairly complete picture of various aspects of the commodity dealt with, such as the supply, demand, price, methods of transportation, marketing, distribution, and utilization. [4]

The above-mentioned investigations of interested workers are of considerable importance. But considering the vastness of the country, the varied character of agriculture and other economic forces, the studies conducted so far are not at all adequate. Systematic work on a country-wide scale is completely lacking. Universities and agricultural institution could do much in furnishing data on the financial side of farming. Government Departments of Agriculture, running so many demonstration farms, if they have any financial results on farming enterprises, are shy about publishing them. Government publications contain reports mostly on the distribution of seeds, implements, bulls, and other forms of propaganda. In spite of the illiteracy of farmers in India much valuable data can be obtained from them. Their system of agriculture is simple and clear-cut. Therefore even their memories can be of great help. They are intelligent. Quite a few of the farmers also know how to read and write an Indian language.

Thorny questions concerning administration and policies cannot be properly tackled without the guidance of costs data. For instance, take land revenue. From the Government point of view it may be equitable, while to a middle-class Zamindar it is a crushing burden, and to a tenant it is still worse; for, according to law, revenue assessed is only a certain percentage of the rental. The fixing of sugarcane prices by the Government in the U.P., and Bihar is fresh in the public mind. While there are other important causes of the unhappy state of both the sugarcane growers and the sugar manufacturers, the absence of the guidance of the costs data has not been of inconsiderable importance.

In 1927, the World Economic Conference adopted a resolution regarding accountancy, the relevant portion of which is quoted here :—[4]

"The fundamental importance of agriculture demands an exact knowledge of its situation. Such knowledge can only be gained satisfactorily through methodical analysis of farm accounts. Such research would bring about a general improvement in agriculture......"

INSTITUTE FARM COST ACCOUNTING

After discussing the various methods of conducting farm business studies, we now come to the discussion of the methods followed in the system of the Institute cost accounting. Any one method of farm accounting may vary in details in different places. It is, therefore, necessary to explain the procedures adopted in accounting at any particular place and also administration, organization, in addition to soil, climate, and practices of farming, before giving the actual detailed data on the individual enterprises.

The Allahabad Agricultural Institute was founded in 1910. Its main work is the teaching of agriculture and allied subjects. Besides purely instructional departments there are other bigger organized activities closely related to education. These are the Departments of Agronomy, Animal Husbandry and Dairying, Agricultural Enginnering, and Horticulture. All matters regarding internal policies and management are decided by the Institute Council which comprises of the Principal, Treasurer, heads of all the departments and a few others. The Institute Treasurer's Office carries on financial accounting for all the departments, based on their daily, monthly, and annual reports. It is this Office which prepares income and expense statements for the departments separately and an income and expense statement and balance sheet for the Institute as a whole. Investigations into fuller departmental details rest with each department.

The accounts dealt with hereinafter are related to the Department of Agronomy or the Farm. Various departments are inter-related and inter-dependent. For instance, for all repairs and work of heavy machinery like tractor discing, threshing and chaff-cutting, the Agronomy Department depends upon the Agricultural Engineering Department,

and it again depends on the former for all haulage of materials. For the supply of fodders the Animal Husbandry and Dairy Department depends upon the Agronomy Department. For the cultivation of orchards the Horticulture Department depends upon the Department of Agronomy. In such ways, departments are connected with each other. But each department charges the other for its supply of services. There is no cancellation of accounts by mutual supply of services.

The aim of the departments is neither to make high profits nor loss. They are essentially educational or experimental in character, having due regard for the business or economic side of the enterprise. There is no particular skill needed in losing money. The accounting system of the Institute farm will be explained, as well as the limitations and the facilities of its organization, situation, soil, and climate, etc., as we proceed further; but meanwhile in studying our figures, this cardinal principle should be well borne in mind by the reader that, while all our activities are not entirely guided by purely commercial ends, at the same time we are not tempted to hide our failures and weaknesses under the cover of education and experimentation.

Books used in the Institute Farm Cost Accounting:—

The "Summary of......account" sheets which are presented hereinafter are the final stage in our system of full farm cost accounting. These are preceded by a number of record books such as (1) Permanent Labour Book, (2) Temporay Labour Book, (3) Daily Operations Book, (4) Summary of Operations Book, (5) Produce Book, (6) Grain Store Book, (7) Miscellaneous Records Book, (8) Inventory Book, and (9) the Ledger. Then there are a few other record books also such as (1) Sales Voucher Book, (2) Marketing Expense Book, (3) Daily Harvest Book, (4) Outward Bills Book, (5) Inward Bill File, (6) Cash Order Book, and (7) Repairs and Supply Order Books. Cash Book and Personal Account Books, etc., for the departments are kept by the Treasurer's Office. For fear of the statement being too lengthy we are avoiding going into the detailed explanation of the above mentioned books.

It will suffice to say that these books have been evolved after many changes during twelve years of accounting work and experience. Each farm needs to keep books adapted to its own particular requirements. Well thought out, strongly bound, properly ruled, and printed books are assets in good accounting. They exert an urge on the record-keeper to make his entries complete and up-to-date. It is false economy not to keep proper books for accounting.

The "Summary.........of Account" sheet has also been evolved here. On the top portion it gives the name of the account, the name of the year, the number of fields, the area (irrigated and unirrigated), and the ledger folio. This will indicate that here the cost accounting has been done crop-wise, not field-wise. Below the top portion come the costs dealt with in five columns. The first column is the operation or items of cost. Then come the items of labour, bullock work and equipment use. The fifth column is the cost in terms of Indian money—rupees,* annas and pies.

Account with Labour:—

One man-day is taken here as a man labour unit. One man regardless of whether it is really a man, woman, or child, working for one day is said to be one man-day. One man working for 10 days, or 10 men working for 1 day will mean 10 man-days. Similar is the explanation for bullock-pair days and equipment days, which are the units of bullock work and equipment use respectively. Equipment means an implement, whether a plough, harrow, cultivator, or cart. Hand tools are excluded. The kind of theequipment used is represented by letters such as R standing for the U. P. plough with the rooter attachment designed for deep ploughing during the hot weather; H standing for harrow; D for seed drills, Cl for cultivator, and C for carts I stands for all sorts of implements used in the preparation of seed bed such as ploughs, harrows, cultivators, plankers, rakes and rollers.

* The rupee is a token coin and full legal tender in India. Linked to sterling, its present exchange value is 1s. 6d. and to the dollar $100=Rs. 328·5; $1=Rs. 3·285; Re. 1=$ 0·3044 or 30·44 cents. Sixteen annas make one rupee, and twelve pies make one anna.

In the case of seed bed preparation, separation of implements is very difficult. P stands for plough alone and T for *thela* or hand cart.

There are two kinds of man labour—permanent or monthly labour, and the temporary or daily labour. The permanent are on monthly pay roll and get Sundays off, get 12 days annual leave, and up to 15 days sick leave in the year with pay. In consideration of all these facts the rate for charging per working day has been worked out for each permanent labourer of whom there are about 21.

The temporary labourers are employed on daily wages and are paid fortnightly. They get no privileges like the permanent ones, and so their rate of daily wages form the rates for charging the operations performed by them.

The rate for charging a bullock*-pair-day to enterprises is Re. 1-4-0. This rate has been worked out by dividing the total cost incurred in securing and maintaining bullocks by the number of days. Bullocks were actually employed at work during the course of a year, for several years.

The daily rate for charging the actual use of implements has also been worked out in the same manner as explained in the case of oxen. The charging rates for charging the use of different implements vary as follows:—

	Per day of use.		
	Rs.	a	p.
The U. P. plough with rooter attachment ..	0	5	0
,, mould board plough	0	3	0
,, Spring or spike tine harrow	0	4	0
,, Bullock-cultivator	0	4	0
,, Wheel hay rake and iron bar roller, each ...	0	8	0
,, 5-spout seed drill	1	0	0
,, One, one-bullock cart (ekki)	0	4	0
,, ,, ,, ,, ,, ,, rubber tyred ...	0	6	0
,, ,, two-bullock ,, ,, ,, ,, ...	0	10	0

*The article 'A study of Bullock Power on the Farm' published in the Allahabad Farmer, Vol. IX, No. 1, January 1935, can give better information on the up-keep and employment of bullocks on this farm.

The cost of wear and tear on hand tools, yokes, plough chains, plankers, ropes and other such small things are included in the rates for charging implements shown above.

The rates for charging enterprises which have been worked out for bullock work and equipments use are a little arbitrary, so are subject to revision from time to time. The above rates for charging for the use of labour, bullock, and equipment may cause surprise to some, but they are necessary if accurate costs are to be kept.

In our system of recording the daily labour reports, the daily operations are first recorded, in the afternoon. The operations are numbered serially. Against each operation will be recorded the number of labourers making no difference between the permanent and casual labourers, number of pairs of bullocks, and equipment in separate columns. The 'Cost' columns are left blank. All this is done in the Daily Operation Book. Then the muster roll call of the labourers is taken, in the evening for which the Permanent Labour and the Temporary Labour Books are useful. The presence of a labourer on a particular day is indicated by noting down the number of operation on which he worked that day against his name, instead of putting down a dot or 'P'. A labourer who is absent is marked 'A'. After the daily operations are recorded and daily attendance is taken, costs are calculated and entered in the cost columns in the Daily Operations Book next morning in the office. This system is such that self-checking can be done in more than one way and thus there is little likelihood of making mistakes.

In order to make the above description clear, a sample of the columns in the Daily Operations Book is given below:—

Date, June 20, 1941.

Operation No.	Operation	Man-labour		Bullock work		Eq.		Total	Folio
		Days	Cost	Days	Cost	Days	Cost	Cost	
1	Ploughing F 12 for maize	5	1-12-0	5	6-4-0	85	0-15-0	8-15-0	S.O. 10

The entries of labour and total cost from the Daily Operations Book are then entered in the Summary of Operations Book in which each of the different crops or enterprises is assigned a particular page When a certain operation for a crop or enterprise is complete, the total of labour figures and cost for that operation are posted in the Ledger.

The procedure of accounting with labour as explained above, is a deviation from the methods advocated and adopted by other investigators in farm accounting. Establishing rates for charging man labour and bullock work and the use of equipment to enterprises makes possible the daily posting of the units of labour employed with their cost in the proper places in the record books. This method gives the complete cost of an operation the very next day. We do not have to wait for the end of the year for the allocation of labour and its cost. The difference between the total costs charged in this way and the actual total cost accruing on account of man labour, bullocks and equipment is immaterial, if the set rates are worked out as accurately as possible and are revised periodically. Our one guiding principle in cost accounting is to manage to leave as few things for adjustments after the end of the agricultural year as possible, with due regard to accuracy.

Other methods of accounting with labour are:—

(1) In cost of production studies, items of cost are shown as man labour, animal work and the use of equipment as separate items. They may be classified as all man labour, all animal work, etc., for the cost of production of an enterprise, or they may be shown under different operations such as ploughing, sowing, harvesting, etc. (2) Another method of labour accounting is to give the items of cost by field operations such as ploughing, etc., and the combined cost of man labour and bullock work is noted against them; the cost of repairs and depreciation on bullocks and on equipment or only on equipment form separate items. These methods also are not free from estimates and have to wait for the allocation of cost figures until the end of the year, or at least until the end of a crop season. These do not give the complete cost of an operation although the total

cost for an enterprise arrived at by all the three methods, including the Institute method, as described above, is practically the same.

In the final stage the costs of the items of man labour, bullock work, and equipment use are not shown separately in the Institute accounting method and this fact may be pointed out as a disadvantage in this system. But to know the cost of these different items separately is easily possible from our final data. The rates for bullock labour and equipment use are set, at which the costs of these two items can be calculated. These two costs, after being deducted from the total cost, will give approximately the man labour cost.

The retaining of labour columns in the final stage of our cost accounting is deliberate. Money costs are much more variable than the quantitative data of labour and equipment employed in the production of a certain enterprise, and vary from place to place, depending upon factors such as rates of wages, the kind and expensiveness or cheapness of bullock feeds, and the condition and kind of farm equipment used, etc. But physical inputs of labour are not so variable, and hence they provide a much better basis of comparison of production data on a number of farms, and on a particular farm itself from year to year either for a particular enterprise or different enterprises. The total cost of an enterprise is made up of the costs of the different operations employed in its production. Therefore, the costliness of different operations can be detected rather conveniently in the method of the Institute cost accounting, and the required improvements can be attempted before long. The effects of the introduction of new type of equipment can also be gauged without much difficulty.

The **'Summary of……Account sheet'** contains complete items of full cost of production of crops and the different items or operations are arranged in order. The first item is manure and manuring:

Manure and Manuring:—

Manuring fields with farmyard manure, green manure or some chemical manure is generally the first operation

performed in connection with the production of crops. It is generally done before the actual seed bed preparation for a crop starts. Sometimes well-rotted old stable manure and some fertilizers may be applied during the process of seed bed preparation and thus may be said to belong to it. Sometimes some fertilizers are applied to standing crops. Yet manuring forms as an item of cost by itself and should not be included with the cost of seed bed preparation. And as manuring generally precedes preparation of fields for sowing rather than following it, the items of manuring and manure has topped the list of items of cost in the 'summary of .... account sheet'.

Manure and manuring in the Institute is a feature of annual adjustments, when at the end of the year the full charges including forking, etc., on manure account have been known. The total charges are then allocated to the quantity of compost applied to the fields and the quantity still remaining in compost heaps. Compost is applied to fields generally by cartloads and the cost of one cartload of compost has varied from Re. 1 to Rs. 1-8 in the last few years. Previously when perhaps as much organic matter or farm refuse was not mixed with the dung, as later, the cost per cartload of compost was coming as high as Rs. 2-8 per cartload. One cartload of compost is approximately half a ton.

All fresh manure and farm waste products composted* together find their way back to the field. The fresh manure with a little amount of bedding is charged at Rs. 2-8 per ton, hauled to the compost sites. It is so arranged that the composts become ready for applications at the manuring seasons in the year, *viz.*, the summer, and September and October. As the composts are generally located near the fields which need mauring, the hauling distance of compost is not long. The first haul of manure is included in the price for fresh manure and the second haul is charged directly to crops for which the ready manure is applied.

There are different methods of charging manure to crops. Manures have residual effects which are utilized by succeed-

*The manufacture of compost as practised on the Institute farm is described in the article 'Compost' in The Allahabad Farmer Vol. IX, No. 4, July, 1935.

ing crops. A fair distribution of manure applied but once in a four-year crop rotation plan on retentive clay soil may be in the proportions of 40-30-20-10. In the similar plan but on open sandy soil the proportions may be 50-40-10-0. The proportion of manure to be charged to succeeding crops for its residual value varies with the soil and many other considerations.

Another way of handling the manure account is to charge it to the farm and then charge the crops a high enough rental for the use of land to cover the cost of manure as well as regular rental. The crops nearest the manure in the rotation then pay the highest rental (2).

Still another way is to charge it to the crop to which manure is applied and at the end of the year credit the crop with part of the manure and carry it to the next year's crop account.

If manuring is done every year, the residual value may ordinarily be ignored.

It has been found that manuring gives decidedly better results under irrigation and for the crops which are profitable. At the Institute farm at present only about one-fifth of the total cultivated area is irrigated. The irrigated area is the most productive and has to be maintained at the highest state of fertility. It is the crops grown on this area which not only pay for themselves, but also pay for the losses in cultivation in the rest of the area. Therefore, most of the manuring here is done on the irrigated area and charged directly to the crop or crops grown in the manured field in the year. The proportion of residual value is not carried from one year to the other. Sometimes when manure is applied towards the end of one financial year, but the crops following are grown after the beginning of the next financial year, this manure is inventoried and shown under Menure Stock Account. Next year the crop expense account is debited and the manure stock account is credited for this manure. The compost heap remaining unapplied at the end of the year is also similarly handled in the accounts.

Green manure is charged at its cost of production to the crop following it. Sheep manuring is also practised at times

by folding village sheep on the fields. The shepherds are allowed free grazing and about an anna per night for each 50 sheep. Both green manuring and sheep folding are done on the poor unirrigated area where fallowing and alternate season cropping are practised.

One short coming which still exists in our manuring scheme is that the fertilizing value of either the fresh manure, compost, green manure or the sheep manure has not been definitely established by systematic manurial analyses and separate manurial experiments. In the absence of such scientific guidance a justifiable evaluation of fresh manure and the proper amount consistent with economic considerations have not been worked out. The supplementing value of chemical fertilizers should also be studied.

Preparatory tillage :—

Next to manure and manuring comes the item of preparatory tillage or seed bed preparation which is again subdivided into dry weather, ploughing, tractor discing, and other bullock operations.

Dry weather ploughing is practised during the winter and the summer after the harvest of the *kharif* and the *rabi* crops. Immediately after the harvest, the land is comparatively soft and the mould board plough drawn by one pair of bullocks is used. The longer the time that lapses between harvest and ploughing, the drier and harder the land gets. Later the U. P. plough with the rooter attachment is used, drawn by two pairs of bullocks. This latter operation breaks the land in big clods and is more expensive than the former.

Sometimes when *rabi* seed bed preparation is behind schedule tractor discing is resorted to. The charge for tractor discing is obtained from the Agricultural Engineering Department, and has to be charged to each crop according to the area disced, and the number of discings.

"Other bullock operations" means operations performed by implements drawn by bullocks, excluding hot weather ploughing and tractor discing. This is done at the sowing season. There are very many such operations. Even in a

single field, a part may be ploughed, another harrowed, still another raked, rolled or planked. So all these operations are classed together and charged to different crops.

Except tractor discing, the operations are recorded, and the cost calculated, and posted daily. In this connection the reader should refer back to the information given under the heading 'Account with Labour.'

Seed and Sowing:—

After preparatory tillage, comes sowing. Sowing is done by three methods, *viz.*, broadcasting, sowing with a seeding spout (*mala bansa*), attached to the country or Wah-Wah plough, and sowing with a five-spout MacCormick seed drill. Now five-spout seed drills manufactured by the Institute have also been introduced and used on the farm.

In the first method seeds are scattered by hand followed by harrowing with spring-tine harrows which partially cover and mix up the seed with the soil. This is a quick method of sowing when moisture is plentiful. The seed rate, however, is not well controlled.

The second method of sowing consists of sowing with the plough drawn by one pair of bullocks. It requires an additional labourer to drop the seed in the seed spout, besides the ploughman. This work demands a certain amount of skill and practice and is generally done by a woman. Seeds fall behind the plough in the furrow. (In a day of 8 hours it sows about half an acre)

In sowing by a seed drill, the seeds are dropped automatically. This does not require the help of an additional labourer. Theoretically the five-spout seed drill should cover five times the area sown with a *mala bansa*, but actually it does 3 to 4 times.

The second method of sowing is the most expensive. It costs about twice as much as the third, and about four times as much as the first method. The first method is generally followed in the *kharif* sowing when the soil is usually moist. The other methods are generally followed in the *rabi*. Sowing

with the *mala bansa* in spite of its costliness, still persists widely in this part of the country. For best results with seed germination when 5-spout seed drill is used, the seed bed should be fine, and the field should be quite level. This drill is under study in the Institute. The disk furrow openers have been replaced by shovels, which is an improvement. The three-spout drill (*tifan*) which is used rather widely in southern India may also be tried here soon.

During the harvest season grains are usually a little cheaper than during the sowing season. So, for grain, crops are credited, and the grain store is debited at the rate prevailing during the harvest time. Later, when this grain is used as seed, the grain store is credited and crop accounts are debited at the rates prevailing during the seeding time. If it so happens that any grain is not more expensive than at harvest time, even then, seed sown is charged to crops at a little higher price in order to cover the storage expenses – fumigation*, shrinkage, dirt, dockage, bags, etc. Any special cleaning of seed at sowing time is charged directly to the crop.

Any seed bought is charged at the market price rate plus cost of haulage, cleaning and wastage, such as may occur in seed potatoes.

Irrigation and Irrigating :—

The Allahabad city sewage is used here for irrigation which covers only about one-fifth of the farm area, as already pointed out. A far greater supply of sewage is delivered by the Municipality on its own land rented out to tenants. It has considerable manurial value and is excellent for enriching poor land. Yet a large amount of this filthy water is let directly into the Jumna.

However, it is a very costly irrigation water. This irrigation water has been obtained on the farm from about 1923. The first contractual rate was Rs. 4,000 per year for the daily supply of one lac gallons; that is, if the Institute

*The method of storing grain on the Institute farm is fully described in an article entitled 'Grain storage', published in The Allahabad Farmer, Vol. VII, no 4, July 1933.

takes this water at the rate of one lac gallons per day it had to pay the Allahabad Municipality Rs. 4,000 annually. This rate continued for some years when the price of sewage was reduced by 50 per cent. This was in force for several years. Later, two years back, the contract was reconsidered by the Municipality and now the rate is Rs. 1,500. The Institute gets sewage about 2 lac gallons per day and so the total sum to be paid to the Municipality comes to around Rs. 3,000. This amount distributed over the irrigated area comes to about Rs. 37 per acre per year. This cost would be higher still if the charge of interest on the investment on the irrigation bunds, tiles and pipes be taken into consideration. About Rs. 50,000 were invested which, if calculated at even 2 per cent per annum, means an interest of Rs. 1,000 or Rs. 12 per acre per year for land commanded by sewage irrigation. However, this item is included with the charge for the use of land.

Sullage irrigation also is a feature of annual adjustment, when the area of all crops irrigated and the total supply of sullage received in the year have been known. This is adjusted according to what is known as a weighted unit system. There is a sullage metre on the farm which records the daily total supply of sullage received but there is no way here of measuring water supplied to different crops and different fields. The adjustment of the amount on account of sullage is based on the comparative value of irrigation to different crops irrigated. For instance, if it is assumed that under average condition this sewage irrigation is equivalent to three irrigations for wheat, then *juar*, a monsoon season crop, may be assumed to derive the value-equivalent to 1½ or 2 irrigations, and potatoes, a dry-season vegetable crop which requires frequent irrigations, may be assumed to derive the benefit equivalent to 12 irrigations, and so on. All crop acres on the irrigated area, multiplied by the assumed number of irrigations for each irrigated crop give the number of crop-acre-irrigations. The total amount to be adjusted divided by the total number of crop-acre-irrigations give a rate per crop-acre-irrigation. The number of crop-acre-irrigations multiplied by this rate gives the amount charged to each crop. By this method the irrigation

charge, which includes the price of the total annual supply of sullage, occasional repairs and of cleaning irrigation channels and the provision of wooden irrigation gates comes to about Rs. 4 to Rs. 6 for *juar*, about Rs. 8 to Rs. 12 for wheat, and about Rs. 34 to Rs. 38 for potatoes per acre, and so on. The labour employed in the distribution of water is charged directly to the crops.

There are two defects in the sewage irrigation arrangement at the Institute. Firstly, the usual daily supply is received almost constantly, and has to be distributed into fields. We have to dispose of water to crops even when they may not need any watering and we do not get more water when additional watering is needed badly. At one time it may result in overwatering or even stagnation while at another the crops may suffer from lack of watering. Secondly, the sewage supply system remains closed for the annual cleaning of the Municipal sewage pumping installation for about three weeks in October and Nevember when irrigation is needed more than at any other time of the year. This causes a definite financial loss for which the Municipality gives no compensation. Yet irrigation being necessary for growing the most profitable crops, where the land is at its best and the cropping intensity at its highest, we have to use and pay for it, in spite of these serious faults.

As already pointed out, irrigation and manuring go together. In spite of the fact that sullage water has manurial value—it contains organic matter and is said to contain considerable nitrogen—the fields have to be manured rather heavily in order to maintain their high standard of fertility. It may be that sullage is far from being a complete manure or that its nitrogen is not in a proper combination. Scientific investigation is again lacking here, which alone can throw light on the matter.

Over-irrigation is bad under all conditions. Over-irrigation with sewage may be worse than over-irrigation with canal water, as it tends to cause what is known as 'sullage sickness'. To retard the cumulative bad effects of sullage irrigation, more ploughing and inter-cultivation are necessary than with well or canal water. Observation leads to believe

that without frequent cultivation sullage reduces the moisture absorbing and retaining capacity of the soil, due to the presence of sullage in it. On the other hand, there appears to be a tendency amongst the farmers on the municipal farm to try to compensate for the deficiency in seed bed preparation and after-cultivation by over-irrigation, which leads to poor yields.

A tube-well water irrigation scheme on the Institute farm has been started. When this is complete much greater facilities will be available for crop production.

Weeding and Roguing :—

Ordinarily, fertile fields have more weeds than poor ones. Conditions which are favourable to the growth of crops, are also favourable to the growth of weeds. Sewage irrigation is a highly fruitful means of introducing and producing weeds. Thus weeding is one of the major problems on this farm.

Still, to a large extent hand weeding is resorted to on the farm, which is slow and expensive. Weeds have to be kept down. Complete eradication is practically impossible. Weeds can be better kept down, quickly and cheaply by the use of the intercultural implements. These implements can be used in standing crops only when they are sown in lines at the required and uniform distance apart. However, in general to permit the use of intercultural implements, for weed control alone, is not quite enough encouragement for sowing crops in rows at proper distances apart, unless other benefits also accrue by doing so, such as quick and cheap sowing operation and good germination of seeds on normal seed bed and better growth of crops.

The full cost of weeding is charged to the crop for which weeding is done. Spike-tooth harrowing is a weeding operation and is shown as such in the accounts given hereinafter. Edible weeds and grasses are fed to livestock, for which the livestock account is debited and the crop account is credited at rates, changing from season to season, which may be thought reasonable. Though this partially affects

the cost of weeding, yet the full weeding cost is shown in cost accounting and any income obtained by feeding weeds and grasses is shown as income to the crop.

The cost of weeding varies according to the amount of weeds present and the character of the weeds. The thinner and smaller the weeds, the more costly weeding becomes. The character of the crop also makes a differance Some crops bear bending and trampling in the young stage, some do not. Whenever the cost of weeding may be expected to equal the value of the standing crop it is better to plough up the crop than to attempt weeding. Formerly, when the Institute was getting its supply of labour through contractors or labour supply agents, it used to pay Rs. 14 per acre for one weeding of potatoes and one cultivating and earthing up by hand labour, the tools used being the *khurpi** and *phaora*†. Since this system was abolished, the same operations have been done with spike tooth harrows, cultivators, and some hand labour, and costs about Rs. 6 only. In Indian agriculture a proper combination of machine work and hand work is bound to go a long way in reducing costs, and raising profits of farming rather than either machine work alone, or hand work alone. That is why the modern improved implements are better known as (hand) labour saving machinery.

Roguing is an operation which is carried out in order to keep a particular variety of crop pure, by pulling out all foreign plants and plants short of the standard in the standing crop after it has formed heads. For instance, in I. P. 4 wheat, all barley, country wheat, and other wheat plants which have developed short beards will be pulled out when they can be recognized by their heads. These green plants are fed to livestock and treated in accounting as edible weeds. The roguing operation is essential in order to obtain pure seed.

Cultivating and Earthing up :—

Weeding and cultivating are closely related operations. The full cost of keeping the crop clean can be assessed by

*A flat, narrow trowel. †A short-handled heavy hoe.

taking into consideration the cost of one or of both the operations, as the case may be. Weeding on intervening spaces between the rows of crops is taken care of by a bullock-cultivator, but for cleaning weeds growing between plants in the rows of crops and also some growing in corners and sides of the fields, hand weeding is resorted to. But in row crops, with the use of a bullock-cultivator, hand-weeding is reduced to the minimum. In crops sown broadcast, cultivating does not come into account.

While the cultivating operation is related closely to weeding on the one hand, on the other it has equally close relation with earthing up. Cultivating, supplemented by hand weeding, if any, is a precedent to earthing up. Earthing up benefits the crops by protecting it against lodging and by providing more feeding area to the roots and more room for the development of the root crop.

Cultivating itself is a partial earthing up. Where this is not enough, hand labour is employed to pull up the loose earth to the top of the ridge, after cultivating. The item of 'weeding', which has already been discussed refers mainly to hand-weeding in which case weeds may have some feeding value as well, whereas this operation under discussion refers mainly to cultivating by the use of bullock power, supplemented sometimes by hand work, if additional earthing up is required.

Harvesting and Hauling:—

The chief means of harvesting crops on the Institute farm are yet the hand tools, sickle and *khurpi*, which are in use all over India.

Harvesting and hauling to the central place on the farm are related. They are so closely linked together in many cases that to account separately for them is difficult and is not of very great use. For instance, in the case of the potato crop each labourer digging potatoes has a small basket with him. When the basket is full of tubers he pours them into a sack left nearby. When all the bags in the field are full, it takes a labourer only a short time to sew all the sacks. Just before they quit work at sunset, many

of them combine, load the bags on to a cart and bring them to a central place. With fodder and grain crops a certain number of the harvesting group would be engaged for the whole day in loading and unloading the cart in hauling, and in addition, all the labourers when they quit work at midday and sunset haul a head load each to the destination. Thus separating accounts for harvesting and hauling is difficult. However, it is quite possible to estimate the proportionate time and cost of each. For hauling, in case of grain and fodder crops, about one-fourth to one-third of the whole harvesting group would be engaged in loading and unloading the cart, and in addition, the cost of the carting unit has to be included. This works out to about 30 to 40 per cent of the combined cost of harvesting and hauling for hauling alone, depending upon the haulage distance. The crops which are less bulky will cost comparatively more for harvesting and less for hauling. Hauling puts a brake on harvesting Harvesting is limited by what can be hauled in a day. Any device which would leave most of the harvesting group to do the harvesting for the whole day and would take care of the hauling with only a small number of men would result in reducing costs and saving time. Agricultural operations have to be finished within a set time. So saving time in the performance of agricultural operations is equivalent to saving costs or raising profits. It enables a farmer to do more in a given time.

Better system of labour employment and increased use of bullock carts here on the farm for the last 8 years have resulted in reducing costs of harvesting and hauling crops from 20 to 50 per cent. Previously there were only iron wheeled carts. Gradually many pneumatic tyred carts also have been introduced. The first cost no doubt, is high but as an investment they prove profitable.

It is being experienced that crops planted in rows make harvesting easier than the broadcast ones. Broadcast crops are subject to more lodging. Row crops because of intercultivation and light earthing up are much less liable to lodge. A lodged crop is difficult to harvest. Moreover, row crops provide well marked out straight rows or strips

for harvesting. This aspect of harvesting may be connected back with that dealt with under "Seed and sowing," and "Weeding and roguing". This shows how agricultural operations are inter-related.

Threshing:—

Most of the *rabi* grains on the Institute farm are threshed by a threshing machine run either by an electric motor or a tractor, under the supervision of the Agricultural Engineering Department. The total amount of the threshing bill is divided by the total amount of grain threshed, which gives the rate per maund. The different kinds of grains threshed are charged accordingly.

Small seeded *rabi* grains like mustard and linseed and all *kharif* grains are threshed by the treading of oxen

The cost of threshing grains with the thresher has varied from about 6 annas to 11 annas per maund of grain threshed About 8 to 9 annas are the normal figures. The cost of threshing with oxen has varied very greatly, *viz.*, from about 4 annas to Rs. 2 per maund of grain, depending upon the nature of grain threshed, weight of grain, proportion of grain to straw, season of threshing, and the threshing floor. Most of these factors affect threshing with the thresher also. About 12 annas to Re. 1 may be taken as the normal cost of threshing with oxen.

The usual practice of calculating cost of threshing grain is on the quantity of grain threshed. But there are two to four times the weight of straw also threshed along with the grain. While in threshing by oxen this stalk material has to give way under the hoofs of oxen, in using the thresher the whole bulk has to pass through and be acted upon by the entire system of the machine. It necessarily results in the greater wear and tear of the machine. Therefore, from two-thirds to three-fourths of the cost of threshing is rightly chargeable to straw. However, even this procedure would not make a difference to the crop as a whole. It is more a matter of comprehension, approximation, and interpretation than splitting of costs.

Straw-breaking :—

Grain straw as it comes out of the thresher is too coarse for feeding directly to livestock, and so has little sale value. Straw or *bhusa* from wheat, barley and gram is not fed on the farm as it is one of the poorest roughages. Instead, silage and green fodders are fed, which are much cheaper and far more nutritive than *bhusa*. But the practice of feeding *bhusa* in India is almost country-wide and deep-rooted. *Bhusa* is an important by-product of crop production in India and so its utilization by feeding to cattle has fitted very well into the small farm economy. It has bulk and so has a good filling quality. There are no industries to untilize straw on a large scale.

Straw-breaking is a charge for breaking *bhusa* more completely so that it is fine enough for market and to be fed. A hammer mill feed grinder run by a motor is employed to do this job. The cost of re-breaking staw is about 4 annas per maund. As already pointed out, *bhusa* is not fed on the farm here but is sold in the city. Its rate has varied from 12 annas to Re. 1 per maund. Most of the time it has been one rupee. *Bhusa* sale brings in ready cash. *Bhusa* is delivered at the door of the buyer in the Allahabad city. Hauling, octroi and overtime allowance on it are borne by the Institute, which amount to about one anna and six pies per maund.

So if the proportionate cost of grain threshing, as pointed out under "threshing," is also included, the cost of *bhusa* delivered to the customer comes from 11 to 12 annas per maund. If sold at the lower price the *bhusa* business is not profitable. If sold at the higher price, it still gives about Rs 1,000 net on the total yearly production, in the duration of one month, which is equivalent to the wheat produced on 15 to 20 acres. If wheat happens to be poor, *bhusa* helps to make up the deficit. Further it makes use of the permanent establishment with which production is carried on.

The Institute *bhusa* is fine It is clean and light because it is free from dirt. Its quality is much superior to the village *bhusa*. As such, the Institute *bhusa* generally brings a higher price. It is expected to bring still a higher

return, if it can be stored through the rainy season when the price of *bhusa* in the city is about 50 per cent higher than its price in May and June. Lack of storage facility compels us to sell all *bhusa* before the monsoon breaks.

Watching.

Watching on the farm is of three kinds, *viz*, (1) general watching, (2) watching standing crops and (3) watching harvested crops on the threshing floor.

There are three watchmen employed permanently on the farm, Their business is to go round and guard against damage from wandering animals, thieves and tresspassers.

Toward the final stages of the standing crops more watchmen are employed to guard against birds in some and in others to protect at night against animal pests such as jackals and porcupines and also against human pests.

One or two watchmen are employed during the threshing season to keep watch especially at night on the threshing floor.

The watching charges are added up at the end of the year and adjusted on the basis of total number of crop-acres Crops requiring more intensive watching are charged a little higher rate. This rate works out to about Re. 1 per crop-acre in the year, leaving out some minor crops.

(*To be continued.*)

We learn wisdom from failure much more than from success. We often discover what will do by finding out what will not do and probably he who never made a mistake never made a discovery.

* * * *

Men of great and shining qualities do not always succeed in life, but the fault lies more often in themselves than in others.

CASUAL OBSERVATION ON CITRUS PSYLLA, DIAPHORINA CITRI KUW.

By

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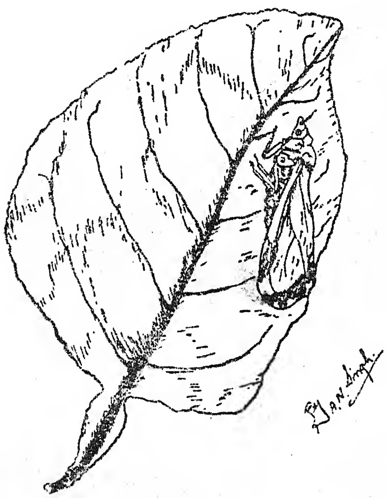
Diaphorina citri Kuw. is a psyllid pest of citrus plants in many places in India. But here at Allahabad it is only occasionally seen and in small numbers. It is a small sucking insect which is responsible for heavy losses in certain places.



The insect breeds all through the year. During winter the life processes are retarded, and consequently the number seen is very small. As soon as the winter ends and the citrus plants are putting out new leaves, the insects are seen in large numbers mostly on the under surface of the young leaves After mating, the females deposit their eggs on the various parts of the plants which hatch into small nymphs, from February to April. It is during these months that the damage is mostly done. Great damage is caused by these nymphs which suck out a considerable amount of cell sap from the leaves and the young shoots. This leaves the trees very weak and unfit for the production of normal healthy fruit. Besides this they also inject a poisnous substance into the plants with the result, that the old leaves fall down, the young shoots wither and in cases of severe attacks the entire plants die out. It also secretes a sugary fluid on the leaves

enabling an easy growth of fungus which mars the normal health of the plant. In all cases of attack, the flowers drop off, the fruit does not reach maturity and is undersized. In cases of heavy attacks no fruit is set at all.

The adult insects are small, winged, brown in colour, and about 2 m.m. in length. The apical margins of the fore-wings have a broad dark brown band They sit in an oblique posture usually on the undersurface of the leaves and on approach jump off from one place to another. The mated females lay a huge number of almond-shaped, yellowish looking eggs on the various parts of the plants. These eggs hatch into small crawling nymphs in about a week in summer and three weeks in winter. The nymphs are flattened dorso ventrally and are more or less oval in outline, and yellowish in colour with an orange tinge on the abdomen. These nymphs reach maturity within four weeks' time, after having changed their skins five times. The adults are usually very sluggish and instead of jumping off when approached they migrate slowly to the undersurface of the leaves and the young shoots. These adults usually live from four to six weeks

Not much has been done here in the way of control, but spraying with contact poisons like tobacco decoction, rosin compound, and soap emulsions has proved quite effective. As tobacco is available in all parts of India, the use of tobacco decoction is always recommended by us for the control of this pest, in preference to the other two poisons. It costs only about an anna for an average size tree. This may be done in winter if the plants have already been attacked or if the insects are seen later, a spraying may be done after the fruit is set. Natural enemies like *Coccinella septumpunctata* L., *Chilomenes sexmaculata* F. etc., have been seen to keep a check on the number of *Diaphorina citri*.

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WHEAT VARIETY TRIALS AT THE ALLAHABAD AGRICULTURAL INSTITUTE FARM

By

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Introduction.

When the Institute was allowed by the Allahabad University to teach three specialized courses in Agriculture, namely, Animal Husbandry and Dairying, Pomology, and Agronomy, it was found that in order to teach the last course properly, the students specializing in the subject would have to know most, if not all, of the important varieties of the major crops of this country, especially of the United Provinces With this in view, and in the absence of the author who was on a study leave at Indore, Dr. E. F. Vestal, Head of the Biology Department of the Institute, and who was then officiating Head of the Agronomy Department, started collecting varieties of crops from different parts of the country as well as from the United States of America. One of the crops he started to work with was wheat. In the *rabi* season of 1936 he came to Indore, and he together with the author, and in consultation with Mr. J. B. Hutchinson, made a scheme of experiment for a wheat variety trial for the Allahabad Agricultural Institute Farm. This experiment was carried out that year with the help of the students who had elected Agronomy for their major subjects. Since then, on the return of the author, the experiment during the following years was modified and more data were taken by the students on the varieties tested. The following paper is therefore a report of the work done on the wheat varieties thus tested during the last five years from 1936 to 1941. All of the data were analysed by the students and later by Mr. S.C.

Bhatnagar, under the direction of the author. Varietal trials on other crops will be published from time to time in this magazine.

In 1936-'37

It was decided in 1936 that the most promising varieties of wheat for the Allahabad area were Cawnpore 13, Pusa 4, Pusa 12, Pusa 111, Pusa 52, Punjab 8A, and Punjab 518. These wheats were to be compared with one another and also with a local variety, so that there were in all eight varieties of wheat to be tested.

The experiment was designed according to Fisherian randomized block layouts. The only data taken that year was on yield. The yield data when an alysed gave the following results:

Due to	degrees of freedom	sum of squares	mean sq.	level of significance	standard error percentage
blocks	5	29·5597	5·9119	1 per cent	..
varieties	7	4·4616	·6373	no significance	..
error	35	26·0987	·7457	..	8·8

The results showed no significant difference in the varieties. This was to be expected, as in the course of the experiment one of the blocks and several plots in the other blocks were very badly infested with white ants. However, the yield data are given below as they are of value in comparing them with the yields obtained in subsequent years from the same varieties.

P. 111	P. 4	Local	Pb. 518	P. 12	P. 52	C. 13	Pb. 8A
25·59	25·27	23·89	23·51	23·51	21·13	21·13	20·25

The above data are shown more graphically in the accompanying diagram.

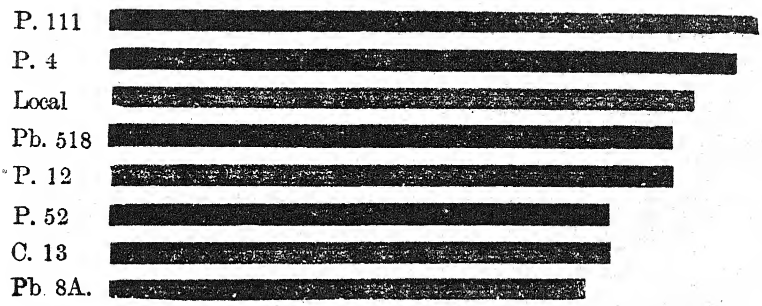

DIAGRAM 1.—Yield of grain of eight wheat varieties under trial, 1936-'37

In 1937-'38

In 1937 the experiment was continued but P. 12 and Pb. 518 were dropped, but two other varieties namely P. 165 and P. 54 were included. In this year three sets of data were taken, one on yield, another on rust incidence and the third on the quality of the grain.

The yield data when analysed gave the following results.

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks	5	33·16	6·63	5 per cent	..
varieties	7	51·29	7·29	5 per cent	..
error	34	88·74	2·61	..	10·65

The conclusion arrived at with the yield data is as follows.

C. 13	P. 54	P. 111	P. 4	P. 52	Pb. 8A	P. 165	Local
43·10	38·23	37·70	35·00	33·90	33·15	24·35	24·10

The above showed that there was no significant difference in yield in the varieties C. 13, P. 54, P. 111, P. 4,

P. 52, and Pb. 8A. But there was a significant difference between C. 13 and P. 165 or the Local.

The above conclusion is shown more graphically in the following diagram:

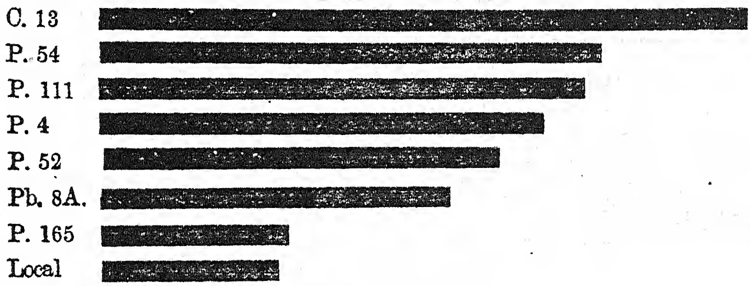

DIAGRAM 2.—Yield of grain of eight wheat varieties under trial, 1937-'38

The incidence of rust was estimated row by row and the maximum marks given per row for the maximum occurrence of rust was 6, and 0 was given for freedom of rust.

The data were analysed and the results arrived at are as follows :

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks	5	119·00	23·80	1% significance	..
varieties	7	3395·83	485·11	highly significant	..
error	35	195·17	5·57	..	11·5

The conclusion arrived at with the data on the occurrence of rust was as follows:

P. 165	P. 4	P. 111	Pb. 8 A	P. 52	C. 13	P. 54	Local
1	26	26	33	39	45	50	178

The rust incidence of these eight varieties of wheat under trial are graphically shown in the following diagram :

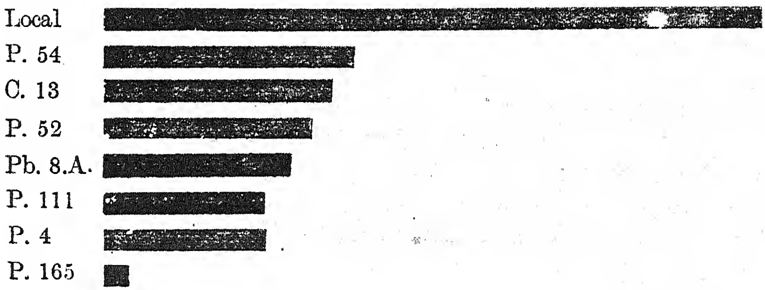

DIAGRAM 3.—Rust incidence of eight wheat varieties in 1937-'38.

That is, in rust resistance as observed by these very crude methods used by students in the field, it was found that P.165 is significantly superior to at least P.52, C.13, P.54 and the local variety, although it is not significantly superior to P.4, P.111, and Pb.8A. All the improved varieties however are significantly superior to the local variety.

The quality of the grain of the above eight varieties were also estimated at random by seven different persons who are acquainted with the market quality of the grain. The grains were placed in order of merit by these seven different men so that the lowest score given by one person to any variety was 1 and the maximum 8. The total of the "block", or of the score of the seven persons in this case, was the same in each. Hence there was no difference between blocks.

These results were analysed and the result arrived at is as follows:

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
varieties	7	246·85	35·26	high significance	..
error	42	47·15	1·12	..	6·3

The conclusion arrived at with the 'quality of grain' data is as follows:

P. 111	C. 13	P. 4	P. 165	P. 54	P. 52	Pb. 8 A	Local
55	47	43	33	23	22	20	9

These data are represented more graphically in the following diagram:

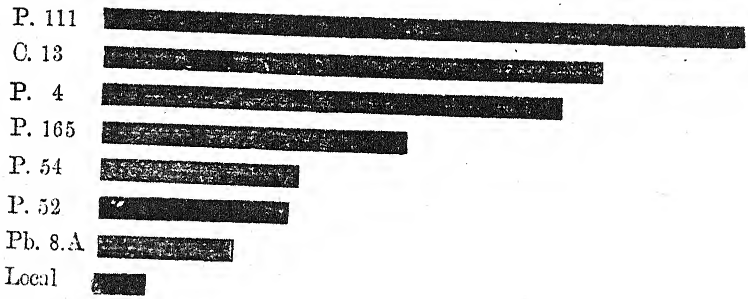

DIAGRAM 4.— Quality of grain of eight wheat varieties under trial, 1937-'38.

The above shows that P.111 is significantly superior to all the other varieties as far as the market quality is concerned; C.13 and P.4 come next, and so on.

In 1938-'39

The trial of those eight varities was continued in 1938-39 *rabi* season. In this year three sets of observations were made. The first was on germination, the second on the resistance to lodging, and the third on the yield of grain. The data on germination were recorded as, this year, the germination varied greatly from plot to plot.

The data on germination were based on estimates made for each row, the maximum for each row was given a grade of 6. In other words if the germination was excellent 6 was given for that row and the variates for the row are added,

and thus we get the values for each plot. The data were analysed, and the results obtained are as follows :

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks ..	5	81·75	16·35	5 per cent.	..
varieties ..	7	118 30	16·9	1 per cent.	..
error ..	35	158·96	4·54	...	4.63

The conclusion arrived at with the data on germination is as follows :

P.52	C.13	Pb.8A	Local	P.54	P.165	P.111	P.4
132	117	116	113	111	109	104	98

The conclusion is graphically represented as follows :

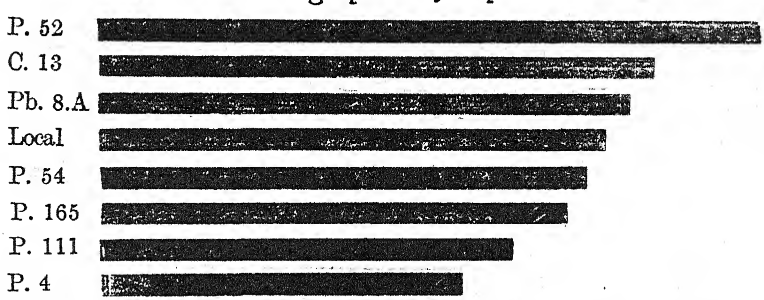

Diagram 5.—Germination score of eight wheat varieties under trial, 1938-'39.

From these data it would appear that P.52 and C.13 are the best germinators. However, this was not corroborated the next year as will be shown later. The probable explanation of this phenomenon is that this year the experiment was laid out on a heavy black soil, similar to the Central Indian soils, or the soils of the Rewa State, which is not far from us.

In this year (1938-39) some rain came when the crop was flowering and this made several varieties to lodge. This gave the students opportunities to make observations on the resistance of the varieties to lodging as far as as can be determined in the field. If the crop in the plot stood perfectly errect in spite of the semewhat heavy rain, a grade of 6 was given, 5 for very good stand, 4 for good, 3 for fair, 2 for bad and 1 for very bad. The data thus collected were analysed and the results arrived at are as follows :

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks ...	5	50·7	10·14	Highly significant.	..
varieties ...	7	67·9	9·7	Do.	..
error ...	35	24·7	·705	...	9·4

The conclusion arrived at is as follows :

P.4	P.111	P.165	P.52	C.13	P.54	Pb. 8A	Local
31	31	26	22	21	20	13	10

The data are more graphically represented in the following diagram :

DIAGRAM 6.—Showing the estimates of resistance to lodging of eight varieties of wheat under trial, 1938-'39.

The data show that P.4, P.111 are the most resistant to lodging although both of them are not significantly superior- to P.165, and that Pb. 8A and Local are the most susceptible to lodging. That is, the latter two seem to possess the weakest stems in the lot. It may be interesting in this connection to note that the first three are awnless and the other five are awned.

The third set of observations made on the wheat varieties under trial that year was that on the yield of grain. The data on yield were analysed and the results obtained were as follows :—

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks :	5	31·34	6·66	No significance	...
varieties	7	1010·74	144·39	,, ,,	...
error	35	386·61	11·04	...	8·1

And the conclusion arrived at is as follows:

P. 111	P. 4	P. 54	P.52	C.13	P.165	Local	Pb. 8A
139·85	115·60	113·60	105·35	98·65	90·10	58·81	58·80

This is shown graphically in the following diagram :

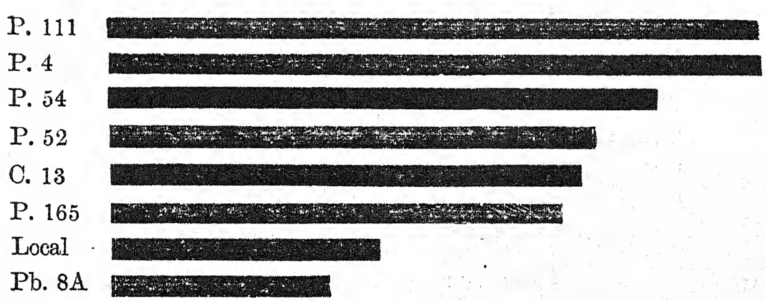

Diagram 7.—Yield of grain of 8 varieties of wheat under trial, 1938-'39.

Thus P. 111 was significantly superior in yield to all the other varieties whereas the yield of a local variety was not even half that of P.111.

In 1939-'40.

In the *rabi* season of 1939-40 only seven varieties were tested. Pb.8A was dropped that year as the performance of this variety as judged by previous results did not prove satisfactory or better than the varieties that were retained that year.

During the season three sets of observations were made on the remaining varieties. Those were on germination, yield of grain and yield of *bhusa* (straw).

It was thought necessary that data on *bhusa* be recorded as this is an important factor which enters into the quality of a wheat variety. *Bhusa* being a very common source of fodder for cattle, it is often necessary that a wheat variety should also possess a quality for a high yield of *bhusa*. However this quality is sometimes considered undesirable when the cost of threshing the grain is considerable. It is often believed that a high percentage of *bhusa* in the wheat crop makes it more difficult for threshing especially when a threshing machine is used.

The first set of data taken that year were on germination. The data were analysed and the following results were obtained :

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks	5	1099·04	219·81	1 per cent	...
varieties	6	267·62	44·60	no significance	...
error	30	818·96	27·30	...	9·6

The conclusion arrived in respect of germination from the data collected that year is as follows :—

P. 4	P. 111	P. 54	P. 165	Local	P. 52	C. 13
154	144	141	137	124	123	105

These data show that none of the varieties are significantly superior to any of the other varieties. The data are graphically represented in the following diagram.

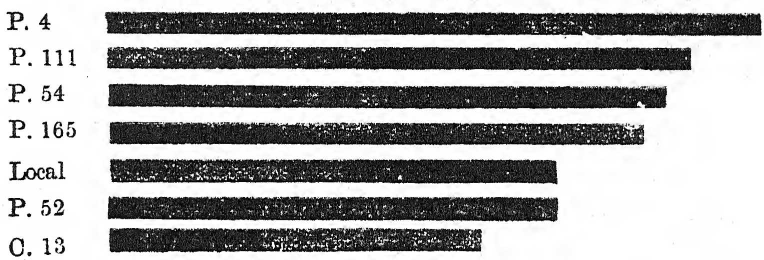

DIAGRAM 8.—Germination score of 7 wheat varieties under trial 1939-'40

These results on the germination seem to be different from those obtained the previous year, and may be accounted for by the fact that the experiment was laid out in different fields in these two successive years, one in which the soil type is heavy black loam, more or less similar to the Central Indian soils and the other to the Indo-Gangetic alluvium.

The analysis of the data on the yield of grain gave the following results :

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks ...	5	120·6246	24.1249	high significance	
varieties ...	6	184·3484	30·7247	high significance	
error ...	30	194.6316	6.4877	...	5·7

The conclusion arrived at is as follows: –

P. 165	P. 4	P. 52	P. 54	P. 111	C. 13	Local
122·90	115·80	115·50	112·15	109·15	97·35	82·80

The data are more graphically represented in the following diagram :—

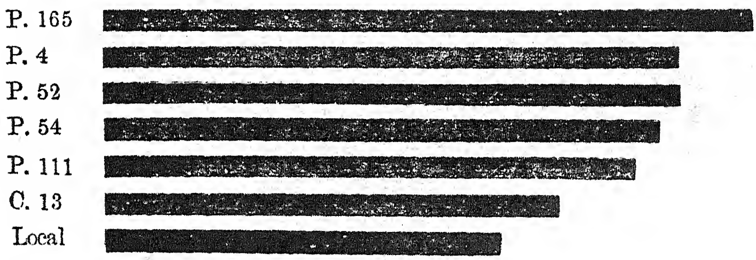

DIAGRAM 9.—Yield of grain of 7 varieties of wheat under trial, 1939-'40

The weights of *bhusa* were recorded and the data were analysed and the following results obtained :—

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks ...	5	352·3350	70·4670	highly significant	...
varieties ...	6	290·0046	48·3341	highly significant	...
error ...	30	315·6983	10·5223	highly significant	4·9

The conclusion arrived at is as follows :—

P. 54	P. 52	P. 165	P. 4	C. 13	Local	P. 111
182·95	181·65	162·80	151·65	149·75	145·20	141·40

The results are graphically represented in the following diagram :—

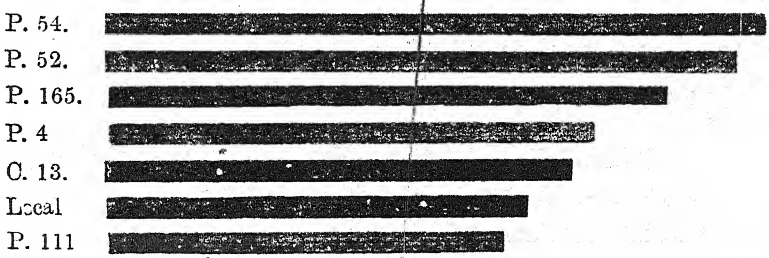

DIAGRAM 10.—Yield of bhusa (straw) of 7 varieties of wheat under trial 1939'40.

In 1940-'41

In the *rabi* season of 1940-41, the number of varieties tested were only six, P. 54 having been dropped as it appears that there is practically no difference between P.52 and P.54 as far as their behaviour and performance are concerned. In this year only two sets of observations were made, one on the yield of grain and another on the yield of *bhusa*.

The data on the yield of grain when analysed gave the following results :—

Due to	degrees of freedom	sum of squares	mean square	level of significance	standard error percentage
blocks ...	7	16·88	2·4	Not significant	...
varieties ...	5	164·53	32·91	Highly significant	...
error ...	35	26·09	·74		5·02

The conclusion arrived at is as follows :—

P.111	P.165	P.4	P.52	C.13	Local
64·0	62·0	61·0	44·0	35·5	25·0

That is P. 111, P. 165 and P.4 are, according to this data, significantly superior to the other varieties but are in the same class by themselves. P. 52 is inferior to the first three but superior to C. 13 and the Local.

The data are graphically represented as follows :—

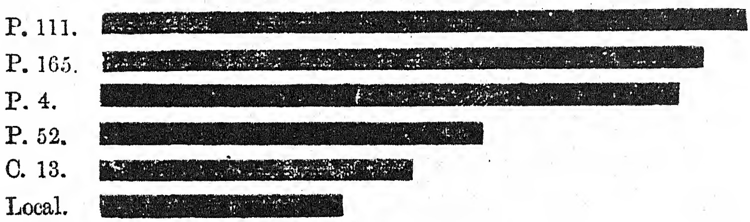

DIAGRAM 11 —Yield of grain of 6 varieties of wheat under trial 1940-'41.

The data on the weights of *bhusa* when analysed gave the following results :

Due to	Degrees of freedom	Sum of squares	Mean square	Level of significance	Standard error persentage
blocks ..	7	273·98	39·14	highly significant.	..
varieties..	5	111·25	22·25	No significance.	..
error ..	35	375·08	10·71	..	4·68

The varieties did not show any significant difference in respect of the weights of *bhusa* although the following yields were obtained :

C. 13	P. 52	Local	P. 111	P. 165	P. 4
214·5	214·0	195·0	188.0	187·5	186.0

The data are graphically represented in the following diagram :

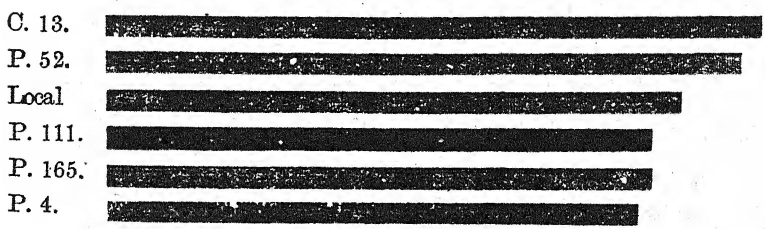

DIAGRAM 12.—Yield of bhusa (straw) of 6 varieties of wheat under trial 1940-'41.

Summary and discussion.

Summarising the above data it seems that our best wheats are P. 111, P. 4, P. 165 of the beardless varieties, and C.13, P.52 or P.54 are the best of the bearded varieties.

P. 111 seems to be superior in yield and in the quality of the grain to P.4 ; whereas in rust resistance, in resistance to lodging, in germination, and in the weight of *bhusa*, they seem to be very much the same. P.165 is by far the best as far as resistance to rust is concerned, but in the most important characteristic, grain yield, it does not seem to be superior to P. 111 or P. 4. It also seems to possess a grain inferior in quality to P. 111 or P. 4. But it is similar to P. 4 in its germinating capacity, in its resistance to lodging and in the amount of *bhusa*.

The behaviour of C. 13 especially with respect to yield seems to be very erratic. While it has done very well in some years and probably under some soil conditions—as the fields are moved about from place to place—it has done very poorly under other conditions. In view of the fact that the quality of the grain of C. 13 is superior to P. 52, and P. 54 and also in view of the fact that C. 13 is a semi-hard to hard wheat whereas P.52 is a semi-hard to soft wheat, the preference for this area for a bearded wheat may be C. 13, even though P. 52 seems to have more *bhusa* than C. 13 and also possesses a *bhusa* of better quality than C.13.

The Punjab wheats seem to be unsuited for this area as they are late maturing and also require a greater amount of irrigation water on that account.

While these experiments have been conducted in our farm under irrigation and usually on areas where a *kharif* crop had preceded the growing of wheat in the *rabi* season we have not so far attempted to grow wheat as most of the local farmers do, that is growing wheat after a fallow in the *kharif* season and without irrigation. It is therefore still very unwise for us to recommend any of these varieties we have tested under our conditions unless we also carry out these experiments under cultivators' conditions that is ploughing the field several times with a *desi* plough during the rainy season in preparation for wheat sowing.

All the above data are collected and analysed by the students so that a very high degree of accuracy could not be maintained. However, we publish them as they throw some light on the characteristics of the various varieties of wheat under trial on this farm.

Let the farmer forevermore be honoured in his calling, for they who labour in the earth are the chosen people of God.—*Jefferson.*

Agriculture for an honourable and high-minded man, is the best of all occupations or arts by which men procure the means of living.—*Xenophon.*

Trade increases the wealth and glory of a country; but its real strength and stamina are to be looked for among the cultivators of the land.—*Lord Chatham.*

In a moral point of view, the life of the agriculturist is the most pure and holy of any class of men; pure, because it is the most healthful, and vice can hardly find time to contaminate it; and holy, because it brings the Deity perpetually before his view, giving him thereby the most exalted notions of supreme power, and the most endearing view of the divine benignity.—*Lord John Russell.*

PYRETHRUM—ITS UTILITY AND POSSIBILITIES.

By

D. P. Majumdar, B. Sc., (*Ag.*)

Pyrethrum is a perennial drug plant and it belongs to the family of Compositæ. The insecticidal property of this plant is known as the "pyrethrin," which is obtained mainly from pyrethrum flowers. The flower which is the chief harvesting material, contains in the stamens and pistils, the insecticidal agent in its most concentrated form. So a proper growth of the flower heads is essential. The highest total pyrethrin content recorded in Kenya is 1·36 per cent and even up to 1·4 per cent. And here in India the highest content recorded is 1·13 per cent from Assam.

Pyrethrum is of two species—one is known as Persian with red or rose pink flowers, and the other is Dalmatian (Yugoslavia) with white flowers. The botanical name of the former is *Chrysanthemum roseum* and that of the latter is *Chrysanthemum cinarariæfolium* which, having gained popularity owing to its more effectiveness, is being cultivated widely. The plant is ordinarily 18 to 20 inches in height.

Origin :—

The original home of the plant seems to be in Persia. During the early part of the 19th century Europe used to import both the plant itself and flower powder from Persian fields and markets to meet a widespread demand for an effective vermifuge. Later on in about 1850—60 a new species of the plant was produced in Dalmatia which gradually proved to be of superior quality to the Persian stuff. Long after this period the plant found its way to other places like Japan, Kenya, etc.

Necessity, Uses and Products :—

Necessity.—In India it is an undisputed fact that every year a fairly large portion of different crops is being

destroyed in the fields, due to insect attacks, and also considerable damage in store-houses is often reported. Thus the total production happens to be much less than what is expected in the beginning. Besides, it is often seen that these insects not only create annoyance to cattle, horses, poultry, etc., and even to human beings, but also create havoc at times as carriers of germs of various diseases. It is therefore of imperative necessity that pyrethrum being an insect-exterminator should be grown in abundance in India in order to remove these pests and save the land from their various depredations.

It is observed that the use of pyrethrum is rapidly increasing in India and that almost the entire supply of the drug is being obtained from Japan. But as Japan is now engaged in a world-wide war the supply of pyrethrum from that country as well as from other foreign lands will be curtailed to a considerable extent. This fact also indicates a greater necessity for growing this crop in India in a very large scale without any loss of time.

Uses.—The uses in brief are as follows :—(1) for anti-malarial work, (2) for extermination of flies and insects on crops, (3) for destroying fleas and lice from cattle, horses and poultry, and (4) for the protection of crops against blight and other diseases.

Products.—An authoritative article (The Pyrethrum Industry of Japan by the British Vice-Consul at Seol, Japan) enumerates a great range of products which can be made chiefly from pyrethrum flowers and to some extent from the leaves and stalks. A brief description of the products may be interesting here. There are three basic products. The first is Flower powder—under this category come the articles known to the trade as "Fly powder," "Insect powder" and "Bug powder"—. These are used to kill the insects of fruit trees, vegetables, cattle and poultry. The second is leaf and stalk powder—as it was found to possess certain insecticidal properties, this powder is either made into mosquito sticks for use in dwellings or mixed with the flower powder in order to be used as a grub killer. This is widely used for purposes of sanitation in Japan. The third is Liquid Extract Mixture—

this extract in different degrees of dilution is used for the extermination of bird lice and vermin.

Again, from the three basic products, there can be obtained no less than six derivative products, namely, (*i*) Pyrethrum Carbon Mixture, (*ii*) Pyrethrum Lixivium: both are used to exterminate the larvæ of the moths and butterflies; (*iii*) Pyrethrum Petroleum Emulsion—this is chiefly used to protect the crops against blight; (*iv*) Pyrethrum Lixivium Petroleum—this is known as the exterminator of dust and dirt carriers; (*v*) Tincture of Pyrethrum—this is mainly used to eradicate the insects which attack cherry, peach and mulberry trees, and to exterminate lice and fleas from cattle and horses; (*vi*) Pyrethrum Powder—its effect is the same as ordinary "Insect powder."

Pyrethrum Production :—

U. S. A. has always been the prominent importer of Japan's export of pyrethrum; *e.g.*, in 1928 about 90 per cent of Japan's exports were taken by U. S. A and the rest was imported by the United Kingdom, France, Germany, Australia, India and Canada combined. The area under cultivation in 1928 in Japan was 26,824 acres, while in 1937 it increased to 60,160 acres and the yield in the same year was 9,912 tons. The production at present is about 10,071,100 lbs. per year, which is valued at 2 crores of rupees nearly. In European countries also the extent of cultivation of this crop is not negligible. In Kenya where the cultivation is a recent one, the area and the yield are both increasing every year. The area planted in 1935-36 was 3,469 acres and the yield was about 582 tons, while in 1936-37 the area went up to 4,624 acres and the yield was about 1,041 tons. Export figure of dried flowers from Kenya has also increased from 32,268 lbs, in 1933-34, to 21,85,792 lbs. in 1936-37. As regards India, the area sown is not known as all the work is almost experimental, except in Kashmir where about 200 acres are under cultivation and the expectation is to increase the area to 1,000 acres and to produce 300,000 lbs. of dried flowers within the next two years. The provinces in India are also on the look-out to expand the areas and to utilise their experimental knowledge in growing it on a large scale in the field.

Cultivation of Pyrethrum in India:—

Pyrethrum cultivation is still in its infancy in India. Of course, trials and experiments conducted through proper channels will no doubt lead towards the success of its cultivation, as had been the case in other countries where it has now occupied an important position in crop production.

Some efforts were made to introduce the crop in this country during the last few years. In the year 1937 the Imperial Council of Agricultural Research seriously considered the matter of introduction of pyrethrum into India in right earnest, and observed that there were possibilities of growing this crop profitably in India and that the matter should be further examined by proper experiments in suitable places. With that end in view the Imperial Council of Agricultural Research got some seeds through the India Office, from the Director, Plant Pathological Laboratory, Harpenden, England, in the same year, and distributed them to different Provinces and States Again, in the beginning of 1940 some seeds were obtained from Dalmatia.

For a number of years, experiments were carried out in different Agricultural Departments with the result that in some places its cultivation had been a failure and in some others it had been hopeful and promising. This crop has fared well and proved to be successful at Murree, Kulu and Palampur in the Punjab, Shillong in Assam, and in Kashmir. Promising results were also obtained from certain parts of Nilgiris and N. W. F. P. But Bombay, U. P., Sind and Mysore are declared as unsuitable for its cultivation.

Analyses for the pyrethrum content of the flower samples obtained from different places show the following results:—Samples from Kashmir and Palampur in the Punjab possess a pyrethrum content of ·95 per cent and ·96 per cent respectively. The pyrethrum content of N. W. F. P. samples ranges from ·61 to 1·11 per cent, whereas the Assam samples contain 1·13 per cent. Indian samples are however still below the level of Kenya samples

Assam, as the product of her soil is found to contain higher percentage of pyrethrum, seems to be eminently suit-

able for the cultivation of pyrethrum; and as such there is a possibility of her being able to compete successfully even with Japan and Kenya.

Experiments have shown that pyrethrum in India thrives well approximately in an altitude of 4,000 feet and above and that it has been observed with certainty that it will grow best in a comparatively dry climate with well-drained light soil. Yields of about 400 lbs. of dried flowers may be obtained per acre, but it may not be the case everywhere. Cultivation methods naturally differ from place to place but the following may be taken as a rough outline of the general procedure.

Cultivation Procedure:—

Soil Tilth.—Land is to be prepared in such a way as to obtain a fine tilth of the soil by repeated ploughings and interculture. Special care must be taken to eradicate weeds completely from the field as otherwise they will destroy the tender seedlings.

Time of Sowing.—There are two sowing seasons, one in the Spring (March-April) and the other in Autumn (September-October). In Kashmir seeds sown in autumn gave the highest germination, whereas April sowing gave a fair result in that respect. In the Punjab sowing is done in March-April. In Assam the highest percentage of germination was obtained from March sowing. The seeds germinate within 10—15 days, but as a matter of course germination depends much on the freshness and viability.

Spacing and Seed Rate.—The most common spacing practised is 18″ × 18″ which proved quite satisfactory. With this spacing about 20,000 plants may grow per acre As regards seed-rate approximately 1lb of seeds per acre will be found adequate.

Method of Sowing.—Before sowing, the seeds are thoroughly soaked in water; they are then wrapped in cloths or sacks and buried in damp sand for 4 or 5 days, after which they are mixed with dry sand and evenly broadcast on a slightly raised seed-bed. As regards the preparation of bed,

Kashmir experiments suggest: "Before the seed is sown, the seed-beds should be prepared a season ahead, so that during this interval it could be made free of weeds by repeated interculture."

Transplanting.—After the land has been prepared well, the seedlings from the nursery are transplanted best on ridges. By 6 to 7 weeks' growth the seedlings become 3″ to 4″ tall and they are then ready for transplanting. Seedlings from Spring sowing may be transplanted from mid-April to July, whereas Autumn transplantation may be done best from mid-October to end-November provided irrigation water is available. Failing that the seedlings may be allowed to over-winter in the nursery bed and then transplanted in early Spring.

Proper selection of transplanting time is very important, for too early transplantation produces poor flowers, while in too late transplantation cold will kill the seedlings before they are able to establish themselves firmly in the soil.

Irrigation.—Water may be applied, if necessary, depending on the soil and climatic conditions. The crop grown in Spring may utilise the rains. Still, if irrigation is considered necessary at all, only one watering may be given provided the Spring is dry. On the other hand more than one irrigation will be needed for autumn planting. Of course all these will depend on the condition of the locality where the crop is grown. Sufficient care must be taken in order to avoid water-logging even for a day or two due to irrigation or rain water. The wet condition of the land will invariably damage the crop.

Drainage.—As inefficient drainage encourages water-logging of the soil, plants in such portions of the field usually die of root-rot. Therefore a slight gradient of the soil is preferable to facilitate drainage. The chief reason why heavy soils do not favour growth is poor drainage.

Manures.—Observations in this respect are incomplete as yet. It has been however found that excessive application of nitrogenous manures gives a luxuriant growth of vegetative parts, but results in an absence of flowers. In less fertile and

sloping soil considerable manuring is beneficial as such land is subject to being washed away more by the rain water than a level and fertile land. Well-rotten cow-dung may be applied with safety. But care should be taken that manuring does not affect flower-formation and the pyrethrin content adversely.

Propagation.—This may be done both by seeds and rooted suckers or splits of the parent plants. For rapid multiplication of the plantation the latter method is advantageous as one can increase by this method the area of his field in a comparatively short time.

Harvesting or picking.—The harvesting or picking is a very delicate operation as on it depends the major part of the success of cultivation. Failure to choose the right time of picking lessens the pyrethrin content and at the same time reduces the yield. The picking season differs in different places, but the operation may be undertaken when the flower-heads are 70 per cent open.

In Kashmir the harvesting season of autumn plantation starts from the beginning of June. In the Punjab pyrethrum flowers about one year after the time of transplanting and therefrom the harvesting starts as soon as the flowers are sufficiently open.

The next important process after picking is the drying of flowers which consists in removing the moisture from the flowers and thereby effecting about 75 per cent loss in weight. The flowers are dried in the sun and marketed in this form.

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REPORT FROM THE UNITED PROVINCES DEPARTMENT OF AGRICULTURE.

OCTOBER, 1941

I—Season.—During the first three weeks of the month, light showers of rain were received in several districts while the whole of the fourth week remained rainless. More rain is needed. Dehra Dun and Bijnor districts recorded rain above the normal.

II—Agricultural Operations.—Agricultural operations are generally up-to-date. Harvesting of *kharif*, the preparation of land for and sowing of *rabi* and the picking of cotton are in progress. Irrigation of late rice and sugarcane continues.

III—Standing Crops and IV—Prospects of the Harvest.—The condition of the standing crops and the prospects, considering the drought of June and July, are fairly satisfactory. There will probably be a shortage of fodder in some of the western districts and the lack of moisture in parts of the Jhansi District may lead to a somewhat unsatisfactory *rabi.*

V—Damage to Crops.—Damage to crops is reported from the Meerut, Bulandshahr, Aligarh, Mainpuri, Bijnor, Moradabad, Pilibhit, Rae Bareli, Sitapur and Kheri districts for want of rain, and due to floods in the Gorakhpur District. Some damage is also reported in Ghazipur, Ballia, Basti and Azamgarh due to hail-storms.

VI—Agricultural Stock.—The condition of agricultural stock is fairly satisfactory. Cattle mortality is on the decline, as the following figures furnished by the Director of Veterinary Services, United Provinces indicate:

Diseases	September		October	
	Affected	Death	Affected	Death
Rinderpest	1,209	641	630	212
Foot and mouth	12,233	48	9,101	58
Hæmorrhagic Septicæmia	1,549	1,298	754	625

VII.—Pasturage and Fodder.—Scarcity of pasturage and fodder are reported from a few districts.

VIII—Trade and Prices.—Prices of the chief food grains, *e.g.* wheat, barley and *arhar dal* have risen slightly, while those of gram and rice have dropped slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month:

	End of September, 1941	End of October, 1941
Wheat	4·614	4·762
Barley	3·069	3·134
Gram	3·670	3·649
Rice	6·534	6·493
Arhar dal	4·487	4·512

IX.—Health and Labour in Rural Areas.—The condition of agricultural labour is satisfactory. Cases of cholera and smallpox are reported from certain districts.

NOVEMBER, 1941.

I—Season.—During the month under report there was practically no rain.

II—Agricultural Operations.—Agricultural operations are in full swing. Sowing and irrigation of *rabi*, harvesting of *kharif*, picking of cotton and crushing of sugarcane are in progress.

III—Standing Crops and IV.—Prospects of the harvest.—The condition of the standing crops and the prospects are on the whole fairly satisfactory, except in dry areas and especially where the rainfall has been in defect. Here there is evidence of seedlings drying up and rain is needed badly.

V—Damage to crops.—Damage to crops due to drought is reported from the Mainpuri, Bareilly, Bijnor, Fatehpur and

Sultanpur Districts, and some damage due to locusts is reported from the Muttra and Budaun Districts.

VI—Agricultural Stock—The condition of agricultural stock is fairly satisfactory. Cattle mortality is on the decline. Hæmorrhagic septicæmia and Foot and Mouth diseases are also declining, but Rinderpest has increased as is evident from the following figures furnished by the Director of Veterinary Services, United Provinces.

Disease	October		November	
	Affected	Death	Affected	Death
Rinderpest	630	212	1,307	776
Foot and mouth	9,101	58	1,922	9
Hæmorrhagic septicæmia	754	625	245	222

VII—Pasturage and Fodder.—Pasturage and fodder are reported to be sufficient everywhere except in the Aligarh, Muttra, Agra, Sitapur and Kheri Districts where a certain amount of scarcity of fodder is reported. Scarcity of fodder is also apprehended in the Etah, Budaun and Jalaun Districts.

VIII—Trade and Prices.—Prices of the chief food grains, *i.e.*, wheat, barley, gram, rice and *arhar dal* have risen. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month:

	End of October, 1941	End of November, 1941
Wheat	4·762	5·312
Barley	3·134	3·399
Gram	3·649	3·905
Rice	6·493	6·790
Arhar dal	4·512	4·925

IX.—Health and labour in rural areas.—The condition of agricultural labour is fairly satisfactory. Cases of cholera and small-pox are reported from certain districts.

December, 1941

I—Season.—With the exception of some light showers received in Meerut, Agra, Rohilkhand and Kumaun Divisions, during the 2nd week, which proved of some benefit to the standing crops, the whole month of December, 1941, was practically rainless.

II—Agricultural Operations.—Agricultural operations are generally up to date. The irrigation of *rabi* crops, crushing of sugarcane and the preparation of land for sugarcane are in progress.

III—Standing Crops and IV.—Prospects of the Harvest.—The condition of the standing crops and the prospects are on the whole generally satisfactory, in the irrigated areas ; but unless it rains very soon in the dry tracts, especially in the west of the province, there will be considerable loss from brought, to the *rabi* crops. The yield of sugarcane is estimated at 65 per cent. of the normal.

V—Damage to Crops.—Apart from drought, some slight damage to crops due to locusts is reported from some parts of the province.

VI—Agricultural Stock.—The condition of agricultural stock is fairly satisfactory except in Bundelkhand and parts of the western districts where the prolonged drought has caused fodder shortage. Cattle mortality from disease is on the decline as is evident from the following figures furnished by the Director of Veterinary Services, United Provinces :

Diseases	November		December	
	Affected	Death	Affected	Death
Rinderpest	1,307	776	931	528
Foot and mouth	1,922	9	1,603	16
Hæmorrhagic Septicæmia ..	245	222	144	100

VII—Pasturage and Fodder.—Pasturage and fodder are reported to be sufficient everywhere except in Meerut,

Bulandshahr, Aligarh, Muttra, Mainpuri, Etah, Jalaun and Kheri where, to a certain extent, scarcity of fodder and pasturage is reported.

VIII—Trade and Prices.—Prices of the chief food grains, *i.e.* wheat, barley, gram, rice and *arhar dal* have risen. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month :

	End of November, 1941	End of December, 1941
Wheat	5.312	5.461
Barley	3.390	3.563
Gram	3.905	4.022
Rice	6.790	6.975
Arhar dar	4.925	5.319

IX—Health and Labour in Rural Areas.—The condition of agricultural labour is fairly satisfactory. Stray cases of cholera, small-pox and plague are reported from certain districts.

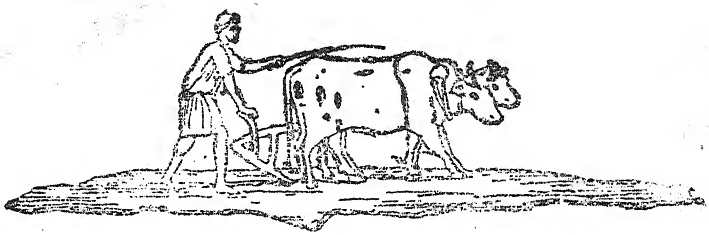
There seem to be but three ways for a nation to acquire wealth : the first is by war, as the Romans did, in plundering their conquered neighbours—this is robbery; the second by commerce, which is generally cheating; the third by agriculture the only honest way, wherein man receives a real increase of the seed thrown into the ground, in a kind of continual miracle, wrought by the hand of God in his favour, as a reward for his innocent life and his virtuous industry.—

Franklin.

In the age of acorns, before the times of Ceres, a single barley-corn had been of more value to mankind than all the diamonds of the mines of India.—*H. Brooke.*

THE

ALLAHABAD FARMER



Vol. XVI] MAY, 1942 [No. 3

Editorials

Farm Cost Accounting

The subject of Farm Cost Accounting is of such great importance that we have given a considerable space in our March and May issues of "The Allahabad Farmer" to an article on this subject by Mr. S. R. Misra of the Agronomy Department of the Allahabad Agricultural Institute. We hope that the article will receive the careful consideration of those who are especially dealing with the whole subject of Agricultural Economics including Farm Management and Farm Book-keeping.

Farming, it must be realized, is as much a business as a manufacturing plant is, for it involves the production and sale of commodities just as much as manufacturing does. Farming therefore must be conducted in a businesslike manner; the aim being, as in many another business, to create the greatest possible profit out of the money invested in farming.

Proper cost accounting is the only way by which a farmer can find out as to how that profit is being made by his business, and can also discover ways and means by which that profit can be increased.

Anyone engaged in farming, however, very soon realizes that the systems of book-keeping usually adopted in business do not fulfil the needs of the farmer. A farm has its peculiar conditions which make it difficult to adopt any of the systems that have been evolved for other business enterprises. Certain principles in farm book-keeping, however, can be used for all farms under all conditions, that once these principles are understood, a system may be evolved for any particular farm.

As Mr. Misra has pointed out in his article, very little attention has been given in this country towards this very important subject of farm book-keeping. We are of the opinion therefore that this article is a very useful contribution for the further study of this subject in this country.

Agriculture and The War.

We note with satisfaction the statement made by our Director of Agriculture in a speech reproduced elsewher in this issue of "The Farmer" that the country must produce more food. The lack of sufficient food and clothing has already been felt in this country. Hence the production of these commodities is becoming increasingly more important. Food is the strongest guarantee we have of preserving our life. And lack of sufficient food, it must be remembered, is one way of endangering the morale of the civilian population of the country. Empty stomachs breed discontent. We hope that Government therefore will do its best to discourage the hit and miss method of farming during these critical times.

"There is a joy in owning a bit of the good earth and in having a garden to cultivate and live in."

—*Rosalie Slaughter Morton.*

SPEECH BY THE DIRECTOR OF AGRICULTURE, UNITED PROVINCES*

AT

THE FARMERS FAIR

Allahabad Agricultural Institute on 5th March, 1942

The Farmers' Fair has become an annual feature of this Institute. It is only *one* of the many good features. The authorities here have gained the confidence of the public and especially of the agriculturists, by their earnest efforts at improving the lot of the farmer through better cattle, better crops and better farming. I have had the privilege of serving on the Board of Directors of this Institute for over 10 years, and I know how very much we all owe to Dr. Higginbottom and the staff of this institution for the many ways in which they have added to our knowledge, and for the many young men and women they have trained for a life of real service to the country.

One of our greatest and most urgent needs in this province as in every other province and state in India at the present time, is the production of more food grains and still more food grains. We used to import 2 million tons of rice from Burma. This has been stopped due to the war. The rains last year were practically a failure and both our *kharif* and the present *rabi* have suffered. Unfortunately, some other provinces are suffering from a shortage of food grains; and when we come to harvest our standing crops, this shortage might not have improved and we may have to look ahead and prepare for future shortage. Fortunately prices are soaring high and might continue at the present level for a long time. There is certainly no fear of a glut of food grains and a consequent fall in prices. This then is an ideal opportunity to put as much area as possible under food crops and to do all we can to increase our outturns on each acre sown.

There are many ways of increasing our outturn of food grains. We could grow them on land which at present grows cotton and other non-food crops. This should be

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*Broadcast from the Allahabad Agricultural Institute radio station.

possible over a fairly large tract and I hope our farmers will do their best to replace cotton by *juar* and other food crops. Cotton of the *desi* type is not required by any one and the prices are too low to make the crop pay. Next year they may be lower. Secondly, to increase food grains we might dig wells for irrigation, but this is expensive and every one can't do it. I hope, however, that those zamindars and village societies who **can** afford it will take advantage of the high prices of food grains and will invest a large part of their profits in digging wells. Thirdly, although some cultivators give their fields satisfactory cultivation, some don't. The result is that the crop is not as good as it should be. This Institute has produced many useful implements and there are others which an average pair of bullocks can pull and which help to get better yields from our fields. I am sure this Farmers' Fair will be instructive in this respect and many farmers will take up the use of improved implements. You have seen the difference between good seed and bad seed, pure seed and impure seed. You can also see here how land which was once almost useless ravine is yielding good crops. This in its economic aspect is of great educative value, since it has been developed scientifically and on practical lines. The Department of Agriculture through its seed stores provides good seed and this if kept pure goes a long way towards increasing production.

Lastly, there is the use of manure. Dr. Higginbottom showed me a crop of potatoes today, which was raised by planting about an ounce (½ chatak) of castor cake with each seed. It is a fine crop, and I hope you will all see it. The Department of Agriculture will help cultivators to get oil cakes and seed of sunhemp for green manuring, at concession rates and I trust our farmers will take advantage of this offer. This is perhaps the quickest way of securing higher returns from our fields and when combined with irrigation and proper cultivation can give the maximum profit possible.

We have, at this Institute, some fine cattle; and you can see the result in the people who live here, of feeding on milk, cream and butter. Our farmers would be able to work

much harder if they got enough milk and *ghee* from their cattle. In the Punjab and the Frontier province the average farmer consumes much more milk than do their brothers in the United Provinces Milk is prized as a very valuable article of food. As an example of this I will tell you a story about a zamindar from the Frontier. He kept a first class cow for the milk which he consumed. A few years ago he got married and when his first child was a year old, his wife and child had to take a long railway journey. The zamindar insisted that the child should have milk from his well fed home cow, on the journey and after. So when he went to buy tickets, he reserved a compartment for his family and asked the railway to reserve another compartment in the same train for his cow. He was very disappointed when this was not allowed.

I hope to launch a small scheme for the improvement of the cattle of this district, by introducing bulls of the Sindhi breed in the villages, in co-operation with the Allahabad Agricultural Institute. I trust that both as regards milk supplies and better draught cattle, the district will be better off in a few years. Meanwhile, I would recommend to the farmers of these parts that they should study the methods employed at this Institute, as regards the production of ample succulent fodder for the milch and work cattle maintained here.

I see that this Farmers' Fair encourages activities in many directions. We have exhibits of the Home Making Department of the Institute and of handicrafts of the villages. Mrs. Higginbottom and the other ladies of this Institute have done and are doing a great service to the villages and homes of the country, by teaching our women how best to utilise their spare time and how to build up healthy and happy homes. I know of no other institution in the United Provinces which is doing more useful work in this cause. To the ladies of this Institute therefore I offer my congratulations no less than to the men who have helped and are helping to build up a great educational institute. I thank the Institute for asking me to open the Farmers' Fair and I have now much pleasure in declaring the Fair open.

TAPIOCA AND THE POSSIBILITIES OF ITS CULTIVATION IN THESE PARTS*

BY

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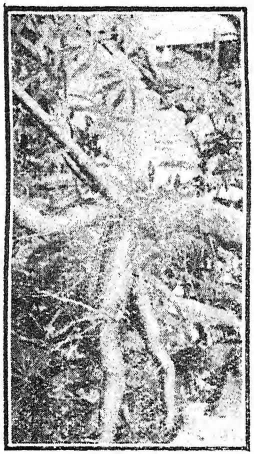
Topioca is said to be the plant that has banished famine from Travancore. Now it occupies about 5 lakhs acres in that state and is an important food stuff among the poor people.



It is indigenous to tropical South America where it was found under cultivation by the first European discoverers. Its introduction to the east particularly the Malabar coast is said to have been effected by the Portuguese in the seventeenth century. Since then its acreage has steadily increased. It is commonly grown as a rotation crop with banana which is heavily manured. In Malaya it is extensively grown as a catch crop in conjunction with young rubber plantations and also as a rotation crop with tobacco and vegetables or sugarcane.

Tapioca, scientifically called *Manihot utilissima*, belongs to the Euphorbiaceae family, and therefore a relative of the castor. It is a shrub with erect stem, 6—7 feet high. Leaves are palmately divided, usually five-lobed. The roots are large and tuberous and grow to a length of over two feet and a thickness of 2 to 4 inches. It is a perennial plant but is cultivated annually.

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* Synopsis of a paper read by the writer in the Institute Staff Seminar, October 1941.

Varieties.—There are several varieties of Tapioca which are known by different names in different localities where these are grown. Some attempts have been made to classify them according to the colour and other characteristics of the root, tuber and stem. From a practical point of view, these are classified into 'bitter' and 'sweet' varieties depending on the prussic acid content of the tubers. The rind of both 'bitter' and 'sweet' varieties contain the same amount of prussic acid (about ·025 per cent) but the average prussic acid content of the flesh of 'sweet' varieties is about 0·01 per eent, as compared with 0·02 to 0·03 per cent in the 'bitter'. It has been observed that changes in climate and environment definitely affect the prussic acid content of the roots. H. F. Macmillan in 'Tropical Planting and Gardening' states that the 'bitter' and 'sweet' types are two species of tapioca named *Manihot utilissima* and *Manihot palmata*; and of these there are several varieties. The bitter one is chiefly grown as a vegetable while the sweet is used mostly as a source of starch.

In the manufacture of tapioca products, the prussic acid is dissolved out of the starch by the water used in its manufacture. The boiling of sliced roots removes the poison as well as the enzyme which liberates the prussic acid. Eating raw tapioca is not safe on account of its liability to be poisonous.

Soil.—Tapioca will grow on almost any well drained soil. A rich sandy loam is the best. It will grow on poor soil as well giving only a poor crop. It cannot stand waterlogging It is considered to be an extremely exhausting crop and is therefore good to follow a heavily manured crop. On very rich soil it is liable to produce more stem and leaves at the expense of roots.

Cultivation.—Its cultivation is comparatively easy. It is planted on flat ground, seldom on ridges. The land is dug over or ploughed once or twice and levelled if necessary. The cuttings which are 5 to 6 inches long are taken from mature stems. These are planted in two ways. In South India the cuttings are planted vertically while in Malaya they are planted nearly horizontally. No data is available to

decide which is a better method. The rows are 4 to $4\frac{1}{2}$ feet apart and the plants $3\frac{1}{2}$ to 4 feet apart in the same row.

Time of Planting.—In South India where the monsoon sets in early, tapioca is planted in April after a few rains. In Malaya also the planting is done in April. Here in Allahabad a few cuttings were planted in February and some in April. These were irrigated all through the summer. The April plantings gave the best results. It is believed that the plant cannot stand severe cold and frost. It might be possible to plant the cuttings in June after a few rains and get a good crop without any irrigation.

Harvesting—Ordinarily tapioca takes about 6 to 8 months to mature. Flowering or fruiting of the plant cannot be taken as a sign of maturity. It can be judged by the size of the roots and also by the proportion of extractable starch. If planted in April it can be harvested in September and the land will be available for "rabi" crops. If left long in the ground after maturity the tubers become woody from the base and the extractable starch will also be reduced. For harvesting, the stems are first cut to within six inches of the ground; the ground is carefully opened all around and the plant is pulled out by hand.

The stems required for planting in the next season are cut into lengths of 4 to 5 feet and stacked in the shade in an up-right position.

Yield.—As with other crops, the yield of topioca also depends on variety, fertility of the soil, climatic factors, etc. The best yield in Malaya is 14 tons per acre. In South India the best yield is only 5 tons, while the average is only 3 tons. Calculating the yield per acre from a few plants grown here, about 5 tons per acre can be expected in these parts. There are wide variations in yields of different varieties.

Diseases and Pests.—There are no serious diseases of this plant. Several insect pests have been reported as attacking tapioca plants but none has caused extensive damage to the crop. In Malabar the major animal pest is

the field rat which begins to destroy the roots from a couple of months after planting.

Uses of Tapioca.—During the season fresh tubers are used as vegetables like *banda,* sweet potato, etc. But towards the end of the season all the roots are harvested and converted into various tapioca products or turned into dry tapioca. Drying is done in two ways. One method is to peel the tubers, slice them into pieces about one-eigth inch thick, and dry in the sun. When well dried the pieces look white. The other method is to slice them as before and boil in water to remove the prussic acid and then dry in the sun. Both of these kinds are for human consumption, for making sweet and savouries and to supplement rice. Some dried tapioca is exported from Travancore. It is used for making biscuits.

The most important commercial product is tapioca flour which is pure starch. India uses over six lakhs tons of starch annually in the textile industry. Most of this is imported from the U.S.A., Brazil, Federated Malay States and Java. Although India grows tapioca in some parts, no starch is manufactured on a large scale. The sweet varieties of tapioca contains 30 to 40 per cent starch. About 25 per cent are extracted by factory method. By using crude methods 15 to 20 per cent are extracted. The extraction of starch from tapioca is simillar to that of potato and other root crops yielding starch. The tubers are pulled and washed well; then the cells are raptured by rasping the tubers. The pulp thus obtained is taken in a large quantity of water and strained through muslin with about 1 m.m. mesh, and the free starch is washed through the strainer as a suspension in water. This suspension is kept in a deep vessel to settle. In about eight hours all the starch settles and a yellow liquid remains at the top. It is removed by decanting and the sediment is taken out and dried in the sun pulverized when dry. The product thus obtained is tapioca starch.

The factory machinery consists of a washer, rasper, sieve and settling tanks. The washing machine is a perforated wooden cylinder revolving at about 15 revolutions

per minute. It is mounted at a slight angle to the horizontal. Dirty roots are thrown into the upper end and the clean ones automatically discharged at the lower end The cleaning is effected by spraying water upon the roots both from a perforated pipe passing through the cylinder and a pipe outside and is assisted by friction of the roots against each other and the sides of the cylinder.

The washed roots are then transferred to the rasping machine which consists of a cylinder composed of a number of radial segments of hardwood bolted together and with double-edged saw blades inserted lengthwise between each pair of segments. The rasping drum is mounted on a steel shaft enclosed in a hardwood box and revolves at a speed of about 600 revolutions per minute. The top of the box is in the form of a hopper into which the roots are fed. There is a wooden trap on one side which is manipulated by a heavy lever. Operation of the lever causes the roots entering the hopper to be pressed against the revolving rasping drum upon which a powerful jet of water is forced on. The pulp comes out with a stream of water through a small opening at the bottom of the box.

The strainer consists of a cylindrical framework, the inner side of which is lined with muslin (of about 1 m.m. mesh). The cylinder is mounted at a slight angle to the horizontal and revolves at a speed of 13 revolutions per minute. The pulp enters at the upper end of the strainer; and during its passage down the cylinder, the free starch is washed through the muslin, and the residue comes out at the lower end.

The suspension of starch in water is collected in cement settling tanks and allowed to remain for about 6 hours. At the end of the period the supernatant liquid is discharged from the tanks through a series of holes at varying heights.

To purify the sediment of starch fresh clear water is added and the sediment stirred vigorously and left for 24 hours for the starch to settle—sometimes the purification goes on for a week changing water every 24 hours. The sediment after purification is taken out, dried in the sun and pulverized.

The commercially important food products are Flake Tapioca and Pearl or Bullet Tapioca.

Flake Tapioca.—The sediment of starch is crumbled and screened through a sieve containing parallel strands. The screened material is cooked in shallow pans for a short time at a temperature of 70° C. stirring with rapid circular motion. Then it is screened through the sieve and dried. The finished product is flake tapioca.

Pearl Tapioca.—The sediment of starch is transferred to "hammock like" contrivance composed of canvas and hanging from the roof. This is rocked with a regular motion which causes the starch to adhere together in the form of small spheres. Next the material is passed through galvanized-iron sieve with round holes which grade the size of particles. The graded material is cooked as in flake, rubbed through a sieve to break up conglomerate particles and then transferred to the drying bench. The dry pearl is next passed between two mill stones; the product is winnowed to separate dust and is subsequently sieved through a fine brass wire sieve. The final product thus obtained is pearl or bullet tapioca.

The poisonous juice of tapioca is also made use of. It is boiled down and is called Cassareep which is a powerful antiseptic, capable of preserving meat, etc. It is also the basis of well-known sauces.

The residue which remains on the strainer is dried and used as poultry and pig feed.

The fact that tapioca can be successfully grown in these parts opens a new field for further investigation. It is a crop which is well worth introducing and developing as a source of starch for which our country depends so much on other countries.

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CONTROL OF INSECTS INFECTING STORED GRAIN AND OTHER PRODUCTS.

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INTRODUCTION

Insect pests became important in stored grain soon after man first learned to keep grain and other products for seed, food and other purposes. The human race in its explorations and migrations usually carried these insects along. Through the development of world trade, many of the most serious insects became cosmopolitan in distribution. Experts have estimated the total annual insect damage in the United States at about two thousand million dollars. Unfortunately there is no such figure available in India, but surely the damage is quite high.

A large number of insects, including many species of beetles, moths and mites attack grain and other products in the farmer's bins, the elevators, mills, warehouses, retail stores and the homes. Many farmers sell their newly harvested crop when the market price is low just to escape depreciation due to insect attack, and are forced to purchase grain shipped in from elsewhere when the prices are high.

Seedsmen deal with product that is to be grown rather than eaten. Any injury that prevents germination and growth of seeds causes a total loss. Some insects destroy the entire seed; others only the germ; in either case the product is of no value as seed. In addition to this actual destruction, planters hesitate to deal with seedsmen who handle seed that is infested in even the slightest degree. In many cases, a few insects in the seed may mean a high percentage of infestation at the time of harvest. Often the amount of grain actually eaten by insects is not so important

as the spoilage of grain by factors secondary to the feeding of the insects, and the potential danger to nearby grain through insect reproduction and spread. D. L. Lindgren in 1935 showed that not only heating of grain is initiated by insects but also by the end products of the use of grain as food by insects, *i. e.* water, heat and carbon dioxide. Water and heat are well known to be important factors in the spoilage of grain. Insects increase grain respiration tremendously. Moisture is given off by both weevils and grain in proportion to their carbon dioxide production. Hence the insects may even start the process of spoilage in grain that would otherwise be in good condition for storage. The lower the temperature, the less the danger from insects' activity.

Also the greatest damage to food by insects is not the amount actually eaten but that which is rendered unfit or undesirable for human consumption by the mere presence of insects. It is not pleasant to think of eating food upon which insects have been crawling and feeding. In some cases an entire business has been ruined because the buying public found insects in its products. The large amount of food thrown away or requiring reconditioning results in losses that could for the most part be prevented at little cost. Carelessness, lack of attention to details, and lack of information regarding a few simple entomological facts are responsible for most of such losses.

In Indian villages there is an idea that insects develop from the "germ" of grain. During the early period of storing the number is very small, and as favourable time comes their number increases rapidly. This fact is responsible for the above idea.

CAUSES OF INFESTATION

1. Infestation in the field.—Certain moths and weevils fly to the grain fields from nearby cribs and begin their attack upon the maturing grain by laying the eggs directly on the "heads," and finally reach the stores with the grain.

2. Infestation in bins and store houses and the holds of grain carrying ships:—All these places, if not properly cleaned,

are themselves badly infested with these insects as there they have held or still hold infested grain. Wooden bins, and the wooden partitions in grain store houses, and the holds of grain-carrying ships become the nesting places for an incredibly large number of grain pests. Certain of these can and do bore into the softer portions of partitions and timber which serve as their hiding place.

3. From sacks:—Uninfested grain get infested by shipment in sacks which previously have been used for grain storage, as they harbour insects.

4. Poor storing:—Grain stored in the open or in poorly constructed cribs or bins may become infested by insects flying in from outside.

5. Flour milling infestation:

(*a*) *Insects entering with grain:*—The insects that attack the sound grain "grind" it, and the material left is much like that which comes from the mill. It is of the greatest importance that the miller should realize the hazard involved in buying grain that has been damaged to any extent by insects. It may contain some of the secondary insects that become primary pests of the milled product.

(*b*) Insects from infested flour returned to the mill from grocer's warehouse and elsewhere.

(*c*) *Insects in returned bags:*—They are passed from one mill to another in empty sacks that are exchanged or returned. Because insects' eggs are not easily seen, sacks may be thought to be free from insects although they contain hundreds of eggs that will hatch in a few days.

(*d*) Insects from second-hand machinery purchased for installation in the plant.

6. Infestation at the grocer's shop:—The causes are practically the same as given above.

7. Infestation at home:—It is easier to rid the kitchen or store of insects before they begin to increase than to do so after every crack and corner in the home is full of the "bug"

family. Moths or beetles found where food is kept, may be coming from a small bag of meal, or an open box of cookies back in some forgotten corner. The reasons for their appearance should be explored immediately, and control measures should be adopted in order to check them.

THE PESTS

1. Rice weevil (*Calandra oryzae*):—This is a small dark-coloured weevil about one-eighth of an inch long with a prominent curved snout. The female lays about 50 to 60 eggs. The eggs are hatched after six or seven days. Each larva bores into the grain with its strong mandibles and eats out a large portion of grain, forming a cavity in which it lies. The insect completes its life cycle in about a month, and there are three or four generations in a year. Accurate statistics of damage caused by this important pest are not available, but the annual loss to rice dealers in Burma alone is roughly put down to amount to several lakhs of rupee. This insect not only infests rice but also wheat, *juar*, maize, etc.

2. Khapra (*Trogoderma khapra*). The adult is a small active brownish black beetle. The female lays 35 to 60 eggs singly or in groups. The eggs hatch in about 5 to 7 days. The grubs are usually brownish, with long hair on the body specially at the posterior end. The grubs eat grain and the attacked portion appears whitish In extreme cases of attack the grain is reduced to flour and dust. The whole life cycle is completed in about a month in the summer and there are usually four generations in a year.

3. The red grain beetle (*Tribolium castaneum*):—This is a small elongate flattish red beetle about one sixth of an inch long. It is extremely common in almost all stored products. The slender elongate white larvae are also found in infested material. It is a special pest of articles like rice, wheat flour, pulses, powders, biscuits, bran, etc.

4. The saw tooth beetle (*Silvanus surinamensis*):—It is known by this name because of the serrated edge of the thorax. It is with red grain beetle a minor pest of stored grain.

5. Paddy borer beetle (*Rhizopertha dominica*):—It is a dark brown beetle about one-sixth of an inch long. Though not so common as the above insects but it occasionally becomes a serious sporadic local pest of stored paddy (unhusked rice.) The adult beetles and their young ones bore through the husk of grain, feed on the contents and turn it into chaff.

6. The tobacco borer beetle (*Lasioderma serricorne*):—It is a pest of dry tobacco in all forms, such as cigarettes, cigars, etc. Both the adult, and the grub which is hairy and curved, bore into dry tobacco.

7. The drug store beetle (*Sitodrepa panicea*):—This is a minute brown beetle one-tenth of an inch long. The larva is non-hairy. It is found boring into all kinds of dry stores like turmeric, ginger, coriander, vegetable drugs of different kinds, and practically all dry vegetables and animal matters.

8. Pulse beetles (*Bruchus chinensis*):—These are roundish beetles about one-fourth of an inch long, with a body abruptly rounded. Their eggs are laid as minute white scales on infested seeds and the thick-set grubs bore into them by cutting a neat hole. They cause great damage to stored pulses like cowpea, gram, lablab, etc.

9. *Bruchus analis*:—It is a serious pest of stored Mung (*Phaseolus mungo*), Moth (*Phaseolus aconitifolious*), *Mash* (*Phaseolus radiatus*) and Rawan (*Vigna catiang*). The adults are very active and are capable of fairly strong flight. The infested stock is reduced to a hollowed out grain in a comparatively short time. The female lays 23 to 150 eggs at the rate of 1—82 eggs per day. Eggs hatch in 6—9 days. It becomes full fed in 8—27 days when it comes to lie next to the seed coat where it turns into a pupa. Pupa stage lasts for 5—13 days. The females live 3—7 days and the males 3—11 days.

10. The tamarind beetle (*Caryoborus gonagra*):—The grub of this insect burrows into preserved tamarind fruit in provision depots. The full grown grub constructs a small oval cocoon for its pupa. These dirty brown cocoons are commonly found on unseeded tamarind pulp kept in bazars.

11. *Tenebroides mauritanicus*:—This is a fairly large dark beetle. It is also found in stored produce This is believed to be partly a pest and partly a predator on other insects.

12. Paddy moth *(Sitotroga cerealella)*:—It is a very shining moth. It is the larva of the moth that bores into the grain and turns it into chaff. It is also found in maize and juar.

13. The meal worm moths :—

(a) Rice moth *(Corcyra cephalonica)*.

(b) Indian meal moth *(Plodia interpunctella)*.

(c) Fig moth *(Ephestia cautella)*.

One or other of these is commonly found on various stored products, *e.g.* juar, maize, rice grains, seeds of groundnuts and various vegetable powders. The caterpillars of these are pale reddish brown or whitish worms found remaining inside tubular galleries made up of the powdery matter, the loose grain, etc., all webbed together in a connected mass.

14. Sweet potato weevil *(Cylas formicarius)*:—Though the infection takes place in the field but it also attacks potatoes if they are stored near the infected sweet potato. The grubs feed the inner content and spoil the stored potato, and sweet potato.

15. Potato moth *(Phthormoea operculella)*:—Like the sweet potato weevil it is also found in fields and stores. It is a store pest attacking stored potatoes in the vegetable godowns. Sometimes it causes serious damage.

To the above list of insects cockroaches, silverfish, house cricket, and termites may also be added. All these insects harm many stored products to a great extent.

CONTROL

I. Prevention :

1. *Harvesting of crop soon after maturing*:—Infestation of grain in the field cannot be entirely prevented, but by proper precautions it can be reduced to a minimum. The first generation of insects in the maturing grain is usually

small, and if the grain is cut as soon as it is ripe, threshed as soon as dry, and then placed in storage in clean, deep bins the damage from this source will be very little.

2. *Not to store unthreshed grain for a long time*:—Unthreshed grain is more susceptible to infestation than threshed one. As such it should be threshed the earliest possible.

3. *Storing*:—Clean grain should never be stored in old bins, granaries or store houses until they have been thoroughly cleaned and freed from accumulation of waste grain and other materials harbouring grain insects. Timbers in bins, granaries or holds of ships that have become infested with grain insects should be destroyed or treated before being used.

4. *Bags*:—Bags of all kinds that have previously held grain should not be allowed in granaries or warehouses or be refilled until they have been sterilized by heat or otherwise freed from insects. The use of air tight cribs will keep the grain free from infestation by insects that might fly in from the outside.

5. *Brief storage*:—Storage of food and other products especially those most liable to insect infection should be as brief as possible. The sooner foods are consumed after their manufacture, the less the chance of infestation.

6. *Poor packing*:—Often a product entirely free from insects when packing becomes infested before it is consumed. Frequently observations indicate that this is usually the result of ill-advised economy in the package stock used.

7. *Construction of building*.—In the construction of buildings in which foods are to be manufactured, it is important to avoid having dark, damp corners inside and beneath the building which are attractive hiding places for insects. The floors and walls are easier to care, for if they are smooth and the corners are rounded and tight.

8. *Cleanliness*.—Cleanliness with respect to insect control under storage condition involves the frequent "clean up" and disposal of accumulation of old lots and foreign material that may harbour and support insect pest of products stored

nearby. When a lot is moved or used up, the space it occupied should be cleaned. Before a new lot is stored, the space it is to occupy should be inspected. Here the best weapons are brooms, air pressure hose and vacuum cleaners.

II. The treatment of infested grain and other products:

1. *Temperature.*—(a) Heat:—A temperature of 120° to 130°F. maintained for a short time will kill all stages of grain infesting insects without injuring the germination of grain. But the heating of grain is not practical unless the moisture content is excessive, otherwise there is weight shrinkage—an obvious disadvantage when grain is sold by weight. When a cereal product is heated the danger is about scorching. For flour used in baking a temperature of 174°F or higher must be avoided.

Experiments on the effect of temperature on the percentage of germination of seed have shown that a temperature of 125° to 130°F for eight hours or more will have little effect. Most of the trouble reported seems to be due to a failure to observe proper precautions. It is necessary to protect seeds near the source of heat much more than those some distance away.

The safest method of handling special products is to sterilize them at the factory and pack them in tightly sealed containers. (Sterilization as used in this connection means freeing the product from all insect life). The "sterilization" of cereal products is usually accomplished by means of fumigation – electricity and heat. The heat method is universally employed.

(*b*) Cold:—Aside from the fact that storage at moderately low temperature is effective in prevention of insect damage because the insects lie dormant, still lower temperatures may be used to kill stored grain insects for they are highly susceptible to freezing.

2. *Contact sprays*:—These sprays kill insects as they come in contact with them. These are only good for insects flying around or located on or near surface that can be sprayed. They are used in warehouses that cannot be

fumigated. They are useful in the home to squirt into cracks and corners of the cupboards and shelves to kill insects and their eggs that cannot be reached by ordinary cleaning method.

3. *Fumigation*:—Poisons in the form of gases used to kill insects are called fumigant. Fumigation is the process of subjecting insect infested material to the fumes of a poisonous gas which would destroy all traces of insects in the material to be stored.

Regardless of the kind of fumigant to be used great care is required to make the enclosure to be fumigated as much air tight as possible. Length of exposure to gas will depend on concentration and on individual substances used which should be thoroughly studied. The fumigator should take proper precautions necessary to make it safe for the surroundings.

The dosage for fumigants is proportioned to the number of cubic feet in the enclosure. Consequently the first step in fumigation is to determine the cubical contents of the enclosure.

SOME COMMON FUMIGANTS

1. Carbon disulphide (CS_2): – It is a colourless ill-smelling liquid which evaporates very rapidly. The gas is deadly to all forms of insect life, if used at sufficient strength. The best dose is about 10 to 15 lbs. per 1000 cu. ft. It is on the whole the best fumigant when much penetration is required.

Cautions:—(1) It is highly inflammable and explosive when mixed with air, for this reason must be used with caution. A flame of any kind, a lighted cigar, or even the spark from a hitting metal or from an electric switch may cause an explosion of the gas.

(2) It may kill the living seed. As such, before treating the seeds the amount of dose and the length of exposure should be determined.

Mixtures of carbon disulphide carbon tetrachloride are now being used. These mixtures consist of a small percentage of carbon disulphide in carbon tetrachloride to which may be added a small quantity of sulphur dioxide. When properly made these mixtures are relatively free from fire hazard.

2. Hydrocyanic acid (HCN):—Of the chemicals employed as fumigants for insects, hydrocyanic acid gas is by far the most extensively used. Four methods are used for the employment of this gas:

(*a*) Calcium cyanide ($Ca(CN)_2$):—No acid is required to generate the gas, the necessary reaction taking place when it is simply exposed to the atmosphere. With 88 per cent calcium cyanide dust, use 3/4 lbs. per one thousand cu ft in a thin layer of not more than 1/8″ thickness. The amount of dust will vary with the percentage purity of dust

(*b*) Hydrocyanic acid gas in liquid form: One pound of liquid hydrocyanic acid is sufficient to treat 3000 cu. ft.

(*c*) By pot methods: In this case the gas is produced in earthen wares placed in the godown to be fumigated. This is done by mixing sulphuric acid and water with sodium or potassium cyanide.

Water	... ...	3 fluid ounces
H2SO4 (Sp. gr. 1·85)	...	1½ „ „
Sodium cyanide (98% pure)	...	1 ounce

The above is sufficient to fumigate 100 cu. ft. of space.

(*d*) By generating the gas by the use of sulphuric acid on sodium or potassium cyanide in solution, in a special chamber or machine and introducing the gas into the enclosure to be fumigated through tubes leading from machine.

Since hydrocyanic acid gas is deadly to human life, this fumigation should be handled with great care.

3. Ethylene dichloride – carbon tetrachloride mixture:—Ethylene dichloride ($C_2H_4Cl_2$) has been recommended mixed with 3 volumes of carbon tetrachloride, to form a non-inflammable, non-explosive, penetrating gas without the bleaching and tarnishing properties and not dangerous to human life. From 12 to 14 lbs per 1000 cu. ft. have been recommended for a 24 hours' exposure against insects of stored products.

4. Chloropicrin:—It is commonly known as tear gas. The dosage varies from two to five pounds of chloropicrin per 1000 cu. ft. It is applied either by atomizing it into the machinery and rooms to be fumigated or by pouring it over sacks hung on the walls or laid over stored products.

5. Methyl bromide:—It is a new fumigant finding considerable application in the food industries in vacuum fumigation. It is non-inflammable. 1 to 2 5 pounds are required to a thousand cubic feet.

6. Ethylene oxide:—It is used mixed with carbon dioxide (one part ethylene oxide and nine parts carbon dioxide) in vacuum fumigation. With the mixture of carbon dioxide it becomes non-inflammable. Twenty pounds to a thousand cubic feet are required

7. Sulphur dioxide:—This gas is not so much effective as the ones described above. This gas destroys the germinating power of most grains and affects the baking qualities of flour, and as such should be used cautiously. Also it has a very strong bleaching action. The dosage used is from 2 to 6 pounds per 1000 feet varying with the insect and material to be treated.

8. Copper carbonate is sometimes used for seeds. This dust also prevents insect damage. Copper carbonate is applied to wheat at a rate of two ounces per bushel (60 lbs). It would not be applied to grain intended for animal or human consumption. Also it prevents the carrying over of disease spore on seed.

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FARM COST ACCOUNTS

IN

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(*Continued from the March Issue*)

Cost of Disposal :—

When a commodity is produced, some is used right on the farm and some may remain unused or as a surplus. This surplus has to be changed to a form which must have universal acceptance and so may be most serviceable under all conditions That form is money. In order to get money the product has to be taken to the market place and sold. In this process there are further expenses which a product has to bear. So in addition to the above-mentioned items of expense, the cost of disposal has also to be included in the list of debit items against a crop.

Hauling to Market :—

Hauling to market is different from hauling of harvests from fields to the central place on the farm, or the threshing floor. The products meant for marketing are generally harvested in the afternoon, and are loaded in the cart which stands overnight close to the barn and leaves for the market very early next morning. The cart generally returns to the farm from the market by noon, and the same process is repeated in the afternoon.

Different products are loaded in different ways. Fodder is loaded in bundles. Grain and potatoes are loaded in sacks. Some green vegetables like tomatoes are loaded in

baskets. Other bulky vegetables like cabbages are loaded loose in carts. These carts have fixed high covered frames on three sides and a moveable shutter on the back. So closed on four sides and open on the top they look like an open box. *Bhusa* is loaded in bigger carts by putting high poles along the sides and tying sheets of gunny sacking around them.

Smaller quantities are hauled in hand-carts or *thelas*. Still smaller quantities of vegetables for local retail sales are occasionally carried as head loads in large flat baskets.

Marketing :—

The term market as we speak of it in ordinary life, means usually a place where the buyers and sellers habitually meet for purchase and sale. But in a wide sense a market refers to a larger field in which the buyers and the sellers are in such intimate contact with one another that the forces operating in determining the value of commodities are known to all, so that the price of a thing is the same all over the field, subject to the cost of transporting it from one part to another.

Such a market can refer to space or time. The market in regard to space may be confined to a locality, or it may extend to a wide region, even to the whole world. The extent of the market depends upon the commodity. From the point of view of time, markets may be divided into several classes, such as the daily market, short period and long period markets. Green vegetables have very limited market in regard to both space and time. Grains have a wider extent. This is only a brief indication of the meaning and extent of market; its fuller discussion is a question of economics.

Allahabad city like other big cities has different market places for different important commodities, such as the grain market (*naj ki mandi*), vegetable market (*sabzi-mandi*), gur* market (*gur ki mandi*) and so on. In the

*Crude brown sugar. Still about 70% of the total production of sugarcane in India is used in the manufacture of *gur*.

people's language a market place is popularly known as *mandi*. In the *mandi* goods are generally sold wholesale to wholesale dealers who again may sell to other wholesale dealers or to retailers.

Marketing requires study, close acquaintance, wide experience, judgment and tact. Methods of marketing different products are different, kinds of market charges or deductions are different, the technique of selling in different *mandis* is different, and weights are different, and the language of each business is different. The whole field of marketing is a vast field, as varied in character and difficult of comprehension as are the various aspects of production. A farmer frequently feels that disposal is more difficult than production. Therefore an exhaustive treatment of any one aspect of marketing is beyond the scope of this paper. However, methods of marketing the Institute farm products can be biefly explained here.

Most of the Institute farm vegetable products are carted each morning in the season to the Khuldabad vegetable *mandi* in Allahabad city. Just on entering the city one comes to the Municipal octroi barrier. All roads leading to the city have such octroi barriers at the outskirts of the city. So no product can pass into the city without paying the necessary octroi charges. Octroi forms the most important item of municipal revenue. The octroi barriers have authorised schedules of octroi rates for different commodities, according to which octroi is charged. But this system admits of much abuse also. The charge for a bullock cart pass is one anna a day. The octroi charge is one anna per maund of wheat, 4 to 5 annas per sack of potatoes or 2 standard maunds, and so on.

In the *mandi*, products are unloaded under the care of a commission man or agent. This commission agent or *arhatia* is engaged for the Institute His business is to sell the products for the owner. He attends to all the details of the sale, including the physical handling* of the goods. The Institute marketing officer collects payments and super-

*Much light is thrown on the aspect of handling vegetables in the Allahabad market in the article. "The marketing of vegetables in Allahabad" by the former marketing officer, Mr. S. K. Roy, published in the Allahabad Farmer, Vol. IV, No. 1, January, 1930.

vises the sales. It needs extremely vigilant eyes to guard against tricks, including the occasional temptations of the commission agent himself. The remuneration of this agent varies from half an anna to one anna per rupee of sales.

Then there is the market contractor. The *mandi* site belongs to the Municipality which used to auction the use of this site yearly or every three years. The successful bidder was known as a contractor for whom the Municipality deputed a clerk in the *mandi* to realize charges daily from all sellers who sold their products there. This charge known as *khonchi* is levied according to different lots of quantities, that is, by number of baskets, bags, cartloads, camel loads and so on. The *khonchi* charge is about one pice or 3 pies per basket of green vegetables, 5 pice per sack of potatoes and so on. Now the Municipality auctions the *mandi* site no more and realizes the *khonchi* charge directly.

The grain market* is organized differently from the vegetable markets. It is much more complicated and the market charges are many. It is more annoying to sell grains in the *mandi* than to sell vegetables.

The Institute grain produce is sold mostly on the farm itself. A considerable quantity of grain is required for the feeding of farm animals. Then the farm people keep buying grain on monthly credits for eating. The U. P. Department of Agriculture also buys seeds for distribution. Occasionally farm grain is sold in the grain market. However, very often it is so arranged that grain is sold on the farm itself to a city grain dealer. The Institute farm is well known to the dealers in the local grain market. They inquire about Institute salaable grains from time to time If the Institute has any surplus grain to sell the marketing officer takes a sample of grain to the *mandi* and thoroughly ascertains its price. Prospective buyers also do the same. Ultimately a bargain is struck at a rate which is equal to the actual market rate less the equivalent of the *mandi* charges and hauling cost, if the product sold is not hauled by the farm carts. By this method the grains are sold at practically the same rate as in the *mandi*, and in addition, all

*For more information on grain markets the reader may refer to the article "Marketing of Wheat in Allahabad" which appeared in the Institute magazine "The Allahabad Farmer" Vol. XIII, No. 4, July, 1939.

unnecessary waiting, botherations, and higgling at the *mandi* are saved. The grain market is quite near the Institute and any fluctuations are soon known to the latter.

Green fodders and *bhusa* are sold in the city to individual buyers. Orders are first received from them and then the products are hauled to their doors. There is no green fodder *mandi*. There are places where individual sellers wait for individual buyers, but they are not organised. There is also a place on the Jumna bank where dry bajra fodder which comes from distant places by boats on the Jumna, is stocked in winter and summer. Both cut and uncut fodder is sold. Individual buyers and sellers get into contact for selling and buying The place is not at all organized like a *mandi*. It is purely a farmer's way of selling.

There are bhusa *mandis* which are better known as bhusa *sattis*. They are meant for small daily sales of *bhusa* for such city cow or other animal keepers as cannot afford to stock a large quantity of *bhusa* at a time. The sellers in the *satti* have to pay only *khonchi* which is one or two pice per large (*bhusa*) basket. Well-to-do keepers of animals in the city generally buy by cartloads in the season enough *bhusa* for their year's requirement.

The system of accounting in relation to marketing has been improved in recent years. All field produce, whether sent to market or supplied for use on the farm, is recorded daily in the Harvest Book. Test weights are taken and the total quantity of each product is calculated at the average weight per unit. For instance, in case of fodder about 8 to 10 bundles for every 100 bundles will be taken out for test weights. These bundles will be taken at random or one bundle after 10 or 12 bundles hauled. The average weight per bundle is found out and at this rate the total quantity is calculated Similar is the case for most vegetables whether they are hauled in sacks or baskets. Vegetables like cabbage, cauliflower, gourds are not weighed; they are counted only. When the products which are sent to market, are sold the next day, the sale transactions are recorded in the Sale Voucher Book, the money is deposited in the Treasurer's Office, and the Cashier acknowledges receipt on the sale voucher.

The Produce Register has two main divisions of columns, one for 'Received' (from the field), and the other for the

'Disposition'. In the farm office, each next day, the figures from the Daily Harvest Book are transferred to the Produce Register in the 'Received' columns, and the figures from the sales voucher and supplies for farm use are posted in the 'Disposition' columns. Each product is assigned separate pages in the Produce Register.

In the sales voucher is also record the daily cash marketing expense. The total marketing expense on a day is distributed among the products sold, according to rates of octroi, *khonchi*, and commission on amount or value of each, and recorded on the back of the sale voucher. This is an estimation work. The marketing expense, as distributed, is posted from the sale voucher to the Marketing Expense Book, in which different products are assigned different pages.

The case with grain is different. It is not marketed direct from the field or the threshing floor. All grain threshed either with thresher or oxen is brought to grain store in open small gunny bags—the bags in which cement is purchased, holding one hundred and twelve pounds each. In the grain store grain is stored in open-top bins, not in bags. The front wall of the bin is 5′-4″. Men pour down the grain from the bag on their heads into the bin. The number of bags of grain brought to the store are recorded and the weight of each bagful of different grains is approximately known by weighing a few bags as test weights. When threshing is over and all grain has been stored, the number of cubic feet of the grain is calculated and this product multiplied by the weight per cubic feet of each kind of grain gives the total quantity. The record of the number of bags also acts as a check on the calculation of quantity in the bin. This method of estimating quantity has been found practically correct and sometimes surprisingly close to the actual when it is known after the total quantity of a kind of grain has been disposed of.

The transactions of grain in the store is recorded in the Grain Store Book. All grain whether used for stock or seed on the farm or sold is actually weighed and then given out.

Other Expenses of Production :

The items of expense mentioned and explained so far are direct expenses of production and disposal. But

there are still some other items which, though they do not have such a direct relation with the production of a crop as the above, are nevertheless indispensable for the successful conduct of enterprises Farm superintendents may not actually work with the soil but they are absolutely necessary for planning ahead and seeing that things are carried out as planned. That great amount of invisible money represented in the shape of land, buildings, equipment and livestock is a direct aid in production. Something must be charged for its use. There are some miscellaneous items of expense, such as office expense, rat control, (*) and other odd things, which cannot be classified along with any of the operations dealt with so far, yet are necessary. These charges must be added to the direct expenses of production in order to ascertain the full cost incurred in the production of crops.

Supervision :

The salaries of all the staff of the Farm Department except that of the head of the department, are charged to farm expense. The head of the department is mostly occupied in teaching work and his salary is charged to Education.

The total annual amount of supervision is distributed over the total annual man-days Wherever man labour is employed there goes with it a charge for supervision also. All work not directly connected with crop growing is charged monthly for all labour done plus a proportionate supervision charge according to the number of man-days at two annas per man-day. At the end of the year the total number of man-days employed through the Farm department and the total amount of supervision expense are known The total number of man-days employed and the amount of supervision charge on all work other than actual crop operations are also known at the end of the year. These latter totals are subtracted from the former totals, and this gives the totals for crop operations. This again gives a rate of supervision charge per man-day for crops, which is a little higher than for non-crop work. Each crop according to its total number of man-days is charged for supervision.

* The method of controlling rats and other burrowing pests as practised on the Institute farm is stated in an article "Control of Burrowing Pests" Published in "The Allahabad Farmer," Vol. VII; No. 3, May, 1933.

Use of Capital:

All production results from the utilization of the four factors or agents of production *viz.*, land, labour, capital, and organization. These agents of production should get proportionate rewards for their use or help in production. Labour is paid for by wages which are included in the cost of production figures. Organisation also is paid for, at least quite largely if not fully, by the inclusion of full supervision charges. But Capital is not paid for by interest yet. Interest only on part of the fixed capital in shape of bullock and equipment is included in the daily rates charged for their use. The method of ascertaining capital value of farm assets is through inventorying.

Inventory:

The term 'farm inventory' is used to designate lists taken at stated intervals, of property, with values affixed, including supplies and produce on hand, together with a statement of the amount of cash on hand and money owing to or owed by the farmer. Inventories are the most important of all farm records (1.)

The stated interval for inventory taking is usually a year. This year is started and ended at a time when the farm activities are at their lowest, when there is least in the way of standing crops out on the farm. The agricultural year in India is from July 1 to June 30, as followed by the Government for the purpose of land revenue. But their financial year starts from April 1 and closes on March 31. Previously in the Institute the financial year was in line with the Agricultural year which was from June 1 to May 31. This was most convenient. But since 1935 this year has been changed to April 1 to March 31, as followed by the Government. From agricultural point of view this measure of the year is not suitable. It begins and ends at a time when there is the most produce on the field and the threshing floor. This is the busiest time of the year. In addition, financial reports at this time split up agricultural accounts.

An inventory is useful in many ways. Taken alone it shows the farmer exactly what he is worth. Comparisons made of inventories taken a year apart will show the rate

of progress or retrogression during the year. It does not show, however, what crops or what animals are responsible for profits or losses. (1)

For convenience the inventory is ordinarily divided into groups to show :—(1) Real estate, (2) Livestock, (3) Machinery and tools, (4) Feed, produce, and supplies, (5) Cash, (6) Bills receivable, and (7) Bills payable. (1)

In the Institute farm accounts work stock, and machinery and tools are inventoried each year. To start with, the first value of work oxen which are bought from market is their purchase price plus the cost of buying and driving from market to the farm. Those which are not bought from a market but are raised here in the Institute Animal Husbandry Department are started at their farm value. The farm value is the market value less cost of hauling or driving to market and selling. Oxen appreciate in value till 5 or 6 years of age after which they depreciate in value. For yearly inventory-taking each animal may be graded according to its average working life which may be taken at 10 years. However, this procedure has not been adopted in our system. At the end of each year the farm staff concerned consider each animal, his age, physical condition, and the market value which he could be expected to bring. On these considerations and judgment each bullock is valued every year. A few appreciate, a greater number depreciate, some die before expectation, and some work longer than expected. During the eleven years of invetorying with bullocks there was slight appreciation in one year only. The other ten years resulted in depreciation which averaged 11 per cent. depreciation on the investment. Depreciation on the full investment has varied from 5 to 18 per cent, 8—12 per cent recurring more often. The yearly investment in bullocks has been approximately Rs. 1,500.

The method of valuing farm implements has also been very similar to that used with bullocks. Their initial cost, physical conditions, and market worth are considered. Above all these, is the practical judgment. The generally recommended way to place the value on a machine is to estimate as carefully as possible the number of years of life remaining; then by considering the age and cost of the machine, a fairly correct value can be assigned. The rate of depreciation on

machinery has been variously estimated as given by Adams at from 6 to 10 per cent. California studies indicate, in general, 10 per cent depreciation a year. (1)

The working life of a machine or implement is affected by many factors such as the kind and material of machine or implement, amount of use, character of soil, housing and care. The average rate of depreciation on implements and tools on the Institute farm for the last 11 years has been exactly 10 per cent. In the early years some old heavy machinery was included in the farm inventory. This resulted in a high and varying rate of depreciation. Later on, it was taken over by the Agricultural Engineering Department. The annual inventory value of implements and tools has been coming down from about Rs. 3,500 to Rs 2,000.

Farm bullock carts are also inventoried. Their average rate of depreciation also has varied within wide limits 7 to 27 per cent. This was due to frequent remodelling of existing carts and the introduction of pneumatic tyred carts, although the annual inventory value varied between narrow limits of about Rs. 1,400 to Rs. 1,800.

Feed, produce, and supplies have also been inventoried but only in as far as they have been connected with grain stock and silage stock. Standing crops at the end of the year have been left out of account in respect of inventory taking.

All grain produce coming in during the course of the year is credited to the crop account and debited to the grain store account at the approximate market rate. All cash sales from the store and seeds for the farm are credited to grain stock. Seeds are debited to crop accounts again and credited to grain stores account. All fumigants and labour used in grain store are debited to it. Thus all credits plus the amount left in stock at the end of the year minus all debits show the net position of the grain stock at the end of the year. An attempt is made to conduct the management of grain stock in such a way so that it evens up at the end of the year, or if there is any difference either for depreciation or appreciation, it is not much, unless there is any abnormal rise or fall in the market price of any grain during the course of the year.

Silage* stocked in silo pits is meant primarily for feeding farm livestock. For all green fodders cut into silo pits for feeding in the course of the year the crop accounts are credited and the silage or Roughage Stock account is debited. The bill for chaffing fodder is also debited to Roughage Stock. When silage is fed, the livestock account is debited and the Roughage Stock account is credited. Any silage left in silo pits at the end of the year is inventoried and the Roughage Stock account is credited. An effort is made in handling this account to have the debits and the credits balance. Ordinarily, there is no depreciation or appreciation in terms of money, but there is depreciation between the quantity of fodder cut into the pits and the silage obtained. This shrinkage has varied from 10 to 40 per cent; commonly it is 20 to 25 per cent. The price of silage per maund is about one and a half times that of green fodder of which silage is made. Sometimes when dry *bajra* fodder was cut in pits and water added to it in order to pack the cut fodder, and to add moisture to it in order to increase the palatibility of the silage and prevent it from molding, silage increased in weight instead of decreasing. However, this difficulty probably does not arise when dry fodder is mixed with green fodder.

It is clear from the above that the nature of inventory-taking with grain and silage stock here is different from that of oxen, implements, and carts.

Accounting or inventorying of cash, bills receivable and bills payable is the business of the Institute Treasurer's Office.

Real estate :

Under real estate are placed land and buildings. In the valuation of land there are at least three bases that may be considered: (1) cost; (2) sale or market value; (3) capitalized rent. (1)

The cost basis in appraising farm lands generally fails to reflect the present value of the land. It does not show the rate of progress or retrogression. Inherited farms cost their

*The method of making silage on the Institute farm and also some other aspects of silage-making are contained in an article "Silo and silage in India" published in the Allahabad Farmer, Vol. IV, No. 2, April 1930.

owners nothing. However, where the land has been purchased recently, cost is the best appraisal basis.

The sale or market-value basis generally proves very practical, but certain precautions are necessary in applying it. As nearly as possible a figure representative of the current price in the neighbourhood of the same kind and quality of land should be taken for appraisal. The current price should neither be forced sale price nor fancy valuation. Almost every farm will include areas of different values per acre. These should be separately priced in accordance with their values. However, in regions where there is little or no buying and selling of farm lands, the scarcity of sales prevent taking of sales prices as a guide.

The third basis is probably the best index of the intrinsic value of land. From an economic standpoint, this is the most accurate method. However, the application of this method is difficult where the land is farmed by its owner. The earnings are produced by the entire farm property – land, buildings, stock, equipment, and labour; and the difficulty lies in allocating to each of these factors of production its true share of the earnings. Due to differences in season and production, the net rent would be more variable and inconstant than the market value basis.

Controversies and difficulties about rent and interest:

Economists say that rent is the differential surplus in the output of a piece of land over the cost of production calculated in terms of land on the margin of production, both in extensive and intensive cultivation. Thus, rent does not enter into the cost of production. The price in the market is fixed in the long run by the marginal cost of production within the limit fixed by demand. This cost does not include rent. Rent does not determine price but is determined by it.

But they also say that while rent does not form an item of cost of production, it must be paid out of what is produced. The net earning of a farm is arrived at after deducting rent. Some investigators in farm accounting have included rent as an item of cost.

From the Government point of view revenue and rent are the first charge on a *mahal**. Land in India is not the absolute property of the people, but the Government has conferred or recognized proprietory rights in land, subject to the payment of land revenue.

The assessment of land revenue is a very complicated affair and revenue is said to form 39 to the maximum of 45 per cent of the 'assets.' 'Assets'† are gross income, distinguished from gross produce or gross rental. Whether revenue is a land rent or a land tax is also not quite agreed to by economists.

How much rent and interest to charge under a given condition? Clear guidance is lacking in the matter. Some include interest on borrowed capital but not on owned capital. Some include both, interest on the purchase price of land and rental value. Rates of interest also vary a great deal.

Sailing across these disagreements and difficulties one has to formulate one's policies and adopt methods under one's conditions. In the ordinary way of thinking rent and interest seem to be quite legitimate charges to be included in the cost of production studies so that the exact position of the farming business be ascertained.

Rent and Interest in the Institute Farm Cost Accounting:—

Farming is a conservative business. Neither are profits speculative nor are losses violent. Capital invested in farming is a very long term investment. It may not give a high rate of returns but should give and does give, if properly conducted moderate returns continuously over a long period of time. In view of these considerations, interest charged on capital investments in farming is rather low, if

**Mahal* means an estate or group of holdings, owned under one title, *i. e.* by a single owner, or by a community or proprietory body, and is the unit of land revenue assessment. (Baden-Powell.)

† The landlord's income is known in official literature as his 'assets.' These 'assets' consist of:—(1) the money rents received from tenants, *plus* (2) the rental value of land held by the proprietor, or allowed by him to be held rent free, *plus* (3) other sources of profit (called in revenue language 'sair'), such as income from jungle products, fruits, and fisheries, and the advantage, of culturable waste land used as pasture land. (Baden-Powell.)

the capital invested is owned, not borrowed. The capital investment in the Institute farm is not borrowed.

The Institute Treasurer's Office carries an account named as 'Plant Funds Assets.' This account is divided into different categories such as Land, Buildings and Improvements, Equipment, Livestock, and Orchards. Their initial cost and any additions from year to year are shown each year in the annual statements. Equipment and Livestock are inventoried each year but land and buildings and improvements are not inventoried. Only the actual costs with yearly cost additions, if any, are carried along in the books. The real worth of the estate,—land, buildings and improvements may be more or less than the worth represented by their cost figures.

Even on the basis of cost data, different areas of different qualities are not classified. The cost of different buildings also are not recorded separately. The items of land, and buildings and improvements should have been run as land and improvements, and buildings.

The Institute accounting systems are being studied and scrutinized carefully and improvements may be expected in the near future. However, for cost of production studies in the farm department, estimated proportionate cost figures of land and improvements, and buildings used by farming activities alone have been separated, as shown under 'Capital Invested in the Farm Business' in the Annual Statement. The total proportionate capital investment including land, averaged per acre on the total cropped area works out at about Rs. 500. The first parcel of land bought was more costly; it makes use of irrigation works and other improvements. The remaining area bought later cost much less and is as yet much poorer. If the capital investment is divided broadly on this basis, the investment on the one area works out at about Rs. 1,000 and on the other at about Rs 250 per acre.

The item of the charge for 'the use of land' to crop production takes into consideration in general both the interest and the rental value of land. At present, the proportionate capital cost is the only basis we can adopt. Interest on the capital investment on land and the permanent

land improvements is charged at 2 per cent per annum. This amount comes to Rs. 3,500 which works out, on the average, to about Rs. 8 per acre per year, as the charge for the use of land alone.

The charge for the use of buildings is the amount of interest calculated at 5 per cent on the estimated proportionate cost of buildings used by the Farm Department.

Then come the charges of interest on investment in bullocks, implements, and carts. Interest on these items is charged at 5 per cent on the yearly average inventory value. The average inventory value is found by adding up the two totals of the inventory value at the beginning and at the end of a particular year, and dividing the totals by 2. (2)

In addition to the above, money has also to be spent in operations connected with a crop, before the produce and income for the crop are obtained. This expense is known as circulating capital. The produce and income for a crop are obtained after different periods of time. The whole duration of a crop is halved, for which time interest is charged at 5 per cent on the total cost of production, excluding those items on which interest has already been charged. (2).

Interest is not charged on the operating expense for the circulating capital for those enterprises which continue to give constant returns. (2) For instance, bullock and equipment which are used at work daily, give constant returns. Such is also the case of milking cows. Some very minor crop accounts have also been excluded from interest charges.

Returns: –

So far costs have been discussed. Now we come to the discussion of returns, that is, the produce and income obtained from the conduct of farm enterprises.

The bottom portion of the 'summary of—Account' sheet shows ruling different from that of the above. The first column is meant for recording the kind of produce, the second column is meant for the yield, either in number or in *maunds* and *seers*. The third column gives the rate at which the products may be sold or consumed on the farm. The fourth column gives the value of the kinds of produce in

terms of Indian money. After totalling the gross value, a balance is struck on the enterprise. It may result either in a surplus or a deficit.

Sheets for non-crop account summaries such as man labour, etc., are ruled differently, as will be seen in the detailed accounts.

All products sold in the market and on the farm, fed on the farm, saved for seed, or used for bedding form credits to a crop. If a farm belongs to a farmer where he uses some farm products for his home consumption, such products should also be noted, valued and credited to crops.

Products which are sold in the market are credited to crops with the full amount actually realised. Costs of marketing are included in the cost of production and disposition of crops. Products fed on the farm are credited at the farm sale value. The farm sale value is the open market value minus the excess cost of hauling to market, and the cost of marketing. (1 and 2).

The real market value of products is ascertained by selling at least part of the products in the market. Occasionally it may be done by only observing the market price. Previous years' market rates may also be taken into consideration. If a product is raised and fed, which is not in demand in the local market, the value of a similar product which is locally marketable, is taken into consideration and the value of that product is appraised accordingly. Or it may be charged at its cost of production.

The other basis for charging products used on a farm is the cost of production basis. It seems that England generally follows the cost of production basis whereas the U. S. A. follows the farm value basis. It is true that in the long run the market prices of commodities should conform to their costs of production otherwise they will cease to be produced. There are many factors affecting market prices. However, the main forces are demand and supply. Their interaction fixes the prices. Demand fixes the upper limit and supply the lower. The buyer always tries to buy at a price which is, as much lower than the maximum as possible; the seller tries to sell at a price which is as much higher than the minimum as possible. If the price is higher

than the maximum, the buyer cannot continue to buy; he will shift to some substitute. If the price is lower than the minimum which is the cost of production, the seller or the producer cannot continue to produce.

Thus in the regular farm business the market value does certainly seem to be the better basis to follow. Market price is a potent factor in determining what to produce and how much to produce. It is a standard by which the relative profitableness of different farm enterprises is ascertained.

Warren is most emphatic in upholding the market value basis. He says, "The usual theory seems to be that if corn and hay can be easily and cheaply grown, they should be fed to livestock. Perhaps the basis of this error is the absurd practice of some institutions of charging feed to animals at the cost of producing it rather than at what it can be sold for, less the cost of marketing. A farmer who produced hay at a cost of $5 per ton might feed it to steers and get $8 for it; by this means he could make a profit on the two things, and steers might be hailed a very profitable enterprise. This sort of figuring is misleading. If hay is worth $15 a ton on the market, a farmer is very foolish to sell it to steers for $8, no matter what it cost him. It would be equally unwise to sell it if he could feed it to cows and get $16 for it. If the farmer whose hay costs him $25 can get only $16 for it by feeding it to cows, he will lose money on the two enterprises, but he should not blame the cows for his loss. Every crop should be disposed of in the way that will pay best, regardless of the cost of producing it." (2)

Concluding remarks:

This is almost the end of the general statement which will be found very helpful in studying, understanding and interpreting the Institute farm cost data which will be printed hereinafter. The foregoing discussions have by no means been exhaustive. They have been merely touched upon in so far as they could throw light on the background of the Institute farm activities and our system of farm cost accounting. Their full discussion forms the subject matter of a full treatise on Farm Management and organization.

However, the quinquennial or decenniel reports based on the Institute farm cost data, when ready, will be far more comprehensive.

The Institute cost accounting was started in the year 1929-30, but due to questions of cost accounting technique and related complicated problems and also to the shortage of staff, the accounts could not yet be arranged in their final order from the beginning. The first year for which the accounts have been so arranged is the year 1938-39, which are now being published. The plan is to work both backward and forward from the year 1938-39, according to the methods adopted now, which will be published as they become ready. This 'general statement' will be followed by 'annual statement' giving summarised studies of the detailed data for each year of cost accounting, the figures for individual labour and crop accounts coming at the end.

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Annual Statement, 1938-39.

First of all, I would draw the attention of the reader to the General Statement on the Farm Cost Accounts of the Institute as the preliminary study of it is quite necessary for the proper understanding of the Institute system of farm record-keeping, the general background of conditions under which production is carried on, and the actual data on this year's farm business that follow hereinafter. Also I would bring to the notice of the reader the fact that for forming opinions, or decisions or for deriving guidance, only one year's figures are not enough. For reliable or trustworthy conclusions no less than five years' figures should be taken into consideration. The greater the number of years for which figures are available and studied, the more reliable will be the inferences or conclusions arrived at. The series of the Institute farm figures for different years will be made available one after the other at no long intervals.

Capital Invested in the Farm Business, 1938-1939

TABLE NO. 1

	April 1938		April 1939	
A. Fixed Capital ...	...	1,92,000	..	1,92,000
Land ...	80,000			
,, improvements	95,000			
Buildings ...	17,000			
Ox barn and stenchions 5,000				
Silos 6,000				
Grain-store 6,000				
B. Working Capital ...	...	10,008	...	10,065
Work-stock ...	1,310	...	1,665	
Dead-stock ...	41,98	...	3,900	
Power-driven machinery ...	...	...	---	
Cash kept in use ...	4,500	...	4,500	
Total	...	2,02,008		2,0,2065
Average	..	..		2,02,037

Table No. 1 shows the capital invested in the farm business for the year under study. The investment rate per acre under cultivation works out to about Rs. 500. It is easily apparent from these figures that the amount of fixed capital looks rather disproportionately high in relation to the amount of working capital, the former being about 95 per cent. The item of power-driven machinery used on the farm such as tractor, tractor harrow-plough, chaff-cutter, thresher, and strawgrinder is left blank, as these outfits, although some entirely and some quite largely are used on the farm, are under the control of the Institute Engineering Department which supplies their services to the farm when needed and charges the full cost of operation to the latter. However, the normal pre-war combined price for the power-driven outfits as mentioned above would be around Rs. 15,000. Assuming their working life as 10 years, the rate of their annual depreciation would be Rs. 1,500

Nevertheless, the inclusion of the item of power-driven machines even in the working capital would not materially affect the proportion of fixed capital, which would in that case be around 90 per cent. The item of power-driven machinery has been mentioned in the table in order to show that the farm has not been operated by bullock power alone.

The inventory figures which stand for work-stock and dead-stock in the table will not give their correct depreciation for the year. Further figuring will have to be done as follows:—

Work-Stock

	April 1938	April 1939	Depreciation '38-'39
Inventory ...	1,310	1,665	...
Purchase of oxen ...	589		
Sale of oxen ...	...	24	...
	1,899 minus	1,689 =	210

Dead-Stock

Inventory ...	4,198	3,900	
Addition to dead stock	481	...	
	4,679 minus	3,900 =	779

Farm Receipts 1938-39.

TABLE No. 2.

	Rs.	Rs.
Direct :		
All *kharif* crops	10,164	
,, *rabi* ,, ...	11,838	
,, vegetable crops	7,025	
,, perennial and other *rabi* fodder crops,	5,238	
,, grasses	1,800	36,065
Indirect :		
Labour with supervision used in other than crop work	3,547	
Bullock work ,, ,, ,,	3,170	
Equipment ,, ,, ,,	666	
Manure ,, ,, ,,	62	
Irrigation water ,, ,, ,,	657	
Miscellaneous receipts	21	8,123
TOTAL		44,188

Farm Expenses 1938-39.

TABLE No. 3.

	Rs.	Rs.
All labour cost	9,675	
,, bullock cost (excluding labour and interest)	6,896	
,, equipment (excluding labour and interest)	1,768	
,, supervision (excluding labour and interest	4,117	
,, cost of tractor discing, threshing by thresher, and *bhusa* breaking by grinder	3,099	
,, cost of seed	2,364	
,, ,, ,, manure	1,370	
,, ,, ,, irrigation water ...	2,567	
,, ,, ,, marketing	992	
Miscellaneous expenses	105	
Total expenses	...	32,953
Interest (Rs. 27,037 @ 5%)	1,352	
Use of land (Rs. 1,75,000 @ 2%) ...	3,500	
Total interest and use of land ...	...	4,852

Table No. 2 gives the summary of farm receipts and the table No. 3 gives the summary of farm expenses for the year. Crops are the main source of income. The other items of income arise as a result of inter-departmental connections and also some items which are not represented by actual crop income, such as labour and supervision spent on manure and grain store accounts.

The total farm expense is fairly well distributed among the different items. Labour is the most expensive item, forming about one-fourth of the total. Therefore, efficient use and control of labour is perhaps the most important problem on the farm.

Some Measures of Success of Farm Business for the year 1938-39

TABLE NO. 4.

	Rs.
Average Capital Invested ...	2,02,037
Farm Receipts	44,188
Farm Expenses	32,953
Farm Income*	11,235
Interest on capital	4,852
Labour income†	6,383
If the operator's time is worth ...	5,000
Per cent return on investment‡ ...	3·09%

*Farm Income is the income from capital and operator's labour for one year. Farm receipts less expenses, including any unpaid labour give farm income. In other words, it is the net income excluding the interest, which has been earned by the operator's capital investment and his profession of farming.

†Labour Income is the sum which a farmer gets for his time for one year, after paying all expenses, and after deducting a charge for the capital he has invested. In other words, it is farm income less interest. This sum is known also as operator's labour income, or operator's earnings.

‡Farm income less estimated value of operator's time, expressed as a percentage of the average capital, is known as per cent return on investment.

In studies of farm management and organization many measurement units are employed for the study of the efficiency and success of the farm business of a particular farm in comparison to other farms similary situated. No one unit of such measurement seems to be absolutely perfect or accurate. Comparable farms are not existent in India. Moreover, only one year's figures with which we have to deal herein can afford no basis for comparison. However, the three units of measurement as shown in table No. 4 will afford a basis of comparison on this particular farm from year to year.

If the investment is large, the per cent made on the investment is considered a more important figure. "But with the amount of capital that is usual in farming, the labour income is much more significant." There is no set formula for determining the value of the farmer's labour. He should expect to get from his business at least what he could get if he would have worked for another person. In our case there is no particular farmer who runs the farm; the Institute itself may be personified as a farmer, the labour income of which goes back to its own further development.

Results on Crops (1938-39)

TABLE NO. 5.

Crops		Total crop-acres	Yield		Value		Cost	
			Total	Per acre	Total	Per acre	Total	Per acre
			Mds.	Mds.	Rs.	Rs.	Rs.	Rs.
Juar	Grain	48·43	66	2·6	6,429	76	3,378	40
	Fodder & Stover		27,509	326·0				
Bajra	Grain	96·00	363	4·0	1,570	16	2,322	24
	Stover		3,092	32·0				
Arhar	Grain	114·00	150	1·3	767	7	674	6
	Bhusa		400	3·5				
Mung	Grain	110·00	34	...	128	1	267	2
	Bhusa		22	...	...	...	...	2
Guara	Grain	19·18	54	5·1	419	22	607	32
	Fodder		1,559	332·0				
Maize	Ears	10·00	...	...	583	58	502	50
	Stover		1,382	138·2				
Paddy	Grain	2·30	1	...	51	22	207	90
	Straw		16	7·0				
Sunnhemp	Grain	7·60	38	5·0	126	17	273	36
	Bhusa		25	3·3				
Soybean	Grain	7·35	12	3·7	91	12	143	19
	Bhusa		17	5·2				
Early *Bajra* Fodder		6·20	3,182	513·0	721	116	241	39
Napier grass ..		9·20	18,204	1983·0	4,101	446	948	103

Results on Crops (1938-39)

TABLE No. 5.

Profit or Loss		No. of man-days		No. of Bullock-pair days.		Equip-days		Crops
Total	Per acre	Total	Per acre	Total	Per acre	Total	Per acre.	
Rs.	Rs.							
3,051	36	3,200	38	582	7	602	7	Grain, Fodder and Stover } *Juar*
—752	—8	2,156	22	649	7	466	5	Grain, Stover } *Bajra.*
93	1	930	8	13	...	10	...	Grain, Bhusa } *Arhar.*
—139	—1	337	3	25	...	8	...	Grain, Bhusa } *Mung.*
—188	—10	538	28	203	10	103	5	Grain, Fodder } *Guara.*
81	8	608	61	47	5	47	5	Ears, Stover } Maize.
—156	—68	309	134	15	6	8	3	Grain, Straw } Paddy.
—147	—19	366	48	38	5	36	5	Grain, Bhusa } Sunnhemp
—52	—7	144	20	37	5	14	2	Grain, Bhusa } Soybean.
480	77	239	39	12	2	12	2	Early *Bajra* fodder.
3,153	343	1,176	128	36	4	71	8	Napier grass.

TABLE NO. 5 – (*Contd*).

Crops		Total crop-acres	Yield		Value		Cost	
			Total	Per acre	Total	Per acre	Total	Per acre
			Mds.	Mds.	Rs.	Rs.	Rs.	Rs.
Guinea grass	...	1·08	1,433	1,327·0	313	290	90	83
Barley fodder	...	3·10	448	145·0	103	33	62	20
Grasses...	...	...	9,863	...	1,725	...	1,626	
Sarpat...	...	...	...	...	75	..	61	
		470·44			17,202		11,402	
Wheat { Grain	...	90·60	1,066	12·0	5,582	72	5,725	63
Wheat { Bhusa	...		2,101	23·2				
Berra, etc. { Grain	...	120 60	1,145	9·5	5,256	43	5,581	46
Berra, etc. { Bhusa	...		1,804	15·0				
Early Potato	...	13·00	2,014	155·0	3,137	241	2,790	214
Hill Potato	...	9·75	1635	167·7	2472	254	1,939	199
Pumpkin	...	14·00	...	...	556	40	389	28
Brinjal	...	1·34	..	...	269	200	193	144
Chilies	...	0·66	...	...	71	108	66	100
Cabbage, etc.	...	1·76	...	...	204	116	231	131
Tomato	...	1·77	...	...	120	68	154	86
Garden pea	...	0·43	...	...	33	77	31	72
Onion	...	0·48	...	...	59	123	90	188
Banda	...	4·60	165	36·0	104	23	492	107
Total	...	729·39	...	...	36,065	...	29,082	...

TABLE NO. 5.—(*Contd*).

Profit or Loss		No. of man-days		No. of Bullock-pair days.		Equip-days		Crops
Total	Per acre	Total	Per acre	Total	Per acre	Total	Per acre	
Rs.	Rs							
223	207	121	112	...	...	...	...	Guinea grass.
41	13	667	21	1	...	1	...	Barley fodder.
99	...	2720	...	25	...	25	...	Grasses.
14	..	77	...	5	...	5	...	*Sarpat.*
5,801	..	12,988	...	1,688	...	1,408		
857	10	4,453	49	645	7	654	7	Grain, Bhusa } Wheat
—325	—3	3,286	27	902	8	877	7	Grain, Bhusa } *Berra, etc.*
347	27	1,400	108	156	12	160	13	Early potato
533	55	1,054	108	95	10	112	12	Hill potato
167	12	226	16	9	...	13	1	Pumpkin, etc.
76	57	179	134	8	6	10	7	Brinjal.
5	8	74	112	1	...	1	...	Chillies.
—27	—15	80	45	3	...	3	...	Cabbage, etc.
—34	—19	167	94	9	5	10	5	Tomato.
2	...	11	25	9	21	9	21	Garden peas.
—31	—65	131	273	1	3	2	5	Onion
—388	—84	469	102	23	5	29	6	*Banda.*
6,983	...	2,4518	...	3,547	..	3,088		

Table No. 5 gives the results on crops grown in the year under study. It shows whole figures; fractions have been eliminated in most cases. It gives both the money costs and the labour units and the value on the full acreage of a crop and per acre. It can be seen that the income from no one crop forms more than about 18 per cent of the total crop-income in the year. Thus, it is easily intelligible that the Institute farming is diversified crop farming. For specialized farming one crop or one source of income should form not less than about 50 per cent of the total year's income.

Then follows the farm weather report for the year and the individual labour and crop accounts. On each account a short statement is also given which will be found of further help in studying the detailed figures.

More interesting studies can be tabulated and graphed from the figures but they have been intentionally postponed to a time when figures for more years will have been made available.

Farm Weather Report 1938-39

Week		Rain for the week	Rain for the month	Normal for the month for Allahabad	Remarks
June					
1st Week	...	0·19	...	...	Early monsoon rain.
2nd „	...	3·68	..	...	
3rd „	...	2·68	..	...	
Last „	...	1·09	7·64	4·85	
July					
1st Week	..	0·58	...	...	
2nd „	...	2·20	...	...	
3rd „	...	5·47	...	...	
Last „	...	4·56	12·81	12·12	
August					
1st Week	...	2·16	...	...	
2nd „	...	5·00	...	...	
3rd „	...	1·81	..	...	
Last „	...	0·46	9·43	11·55	
September					
1st Week	...	13 28	...	...	The heaviest rainfall of the year.
2nd „	...	0·93	...	...	
3rd „	..	0·46	14·67	5·78	
October					
1st Week	...	0·13	...	...	
2nd „	...	2·03	2 16	2·21	Good rain for seed bed preparation for *rabi*.
November		Nil	Nil	0·27	
December		Nil	Nil	0·26	
January 1939					
Last Week	...	0·78	0·78	0·74	Good for *rabi* crops.
February					
3rd Week	...	0·22	0·33	0·53	Late winter rain. Not good but not very harmful on the whole.
Last „	...	0·11	...	...	

Farm Weather Report 1938-39.—(*concluded.*)

Week		Rain for the week	Rain for the month	Normal for the month for Allahabad	Remarks
March		Nil	Nil	0·30	
April					
1st Week	...	0·22	0·22	0·14	
May		Nil	Nil	0·31	
Total	...		48·04	39·06	

NOTES

Due to a few light showers of rain in April and May and the early break of monsoon the summer in Allahabad was not so hot and scorching this year as usual. April was hotter than May and June.

The monsoon rains set in earlier than usual by nearly two weeks. However, the first rain worth counting for agriculture, fell on June 12th. that is, 1·59 inches. So *kharif* sowing started earlier this year by about one week. The character of the rain fall was very good, it being almost continuous without unsatisfactory breaks from about the middle of June through the end of August. Except for the defect in the germination power of the *juar* seed, which accounted for the reseeding of certain fields, fodder crops, on the whole, did very well.

The heaviest rainfall of the year (10·48″) fell on September 4 followed by 2·13″ on the next day. It was very disappointing to see the bunds and dams cut and washed away at so many places as perhaps never occurred before. Fodder in many fields also lodged rather badly.

Light showers amounting to 2·16″ in the middle of October were favourable for *rabi* sowing. However, it did damage part of potato crop. The rain during the last week of January was quite helpful, though about a week earlier it would have been much better. The rain in the last week of February was contrary in its effect to that of the last week of January. It did some damage to the hill potato crop and vegetables also.

The year was free from frost and hailstorm. Harvesting and threshing in March and April proceeded unhampered by rain. High temperature in April caused considerable rotting of hill potatoes in field and store.

Excepting the serious damage done to permanent land improvement works by the rain of September 4, otherwise agriculturally the year was quite good. We had good harvests.

The rain in the year was above normal by 9″.

Summary of Labour Account April, 1938 to March, 1939

Ref. No. L. 34

Items of expense	Permanent man-days	Temporary. man-days	Total man-days	Amount Rs.	a.	p.
To employment of labour and payment of wages in April 1938 ...	524	3142	...	1,008	2	0
To employment of labour and payment of wages in May 1938 ...	537	1552	...	658	0	9
To employment of labour and payment of wages in June 1938 ...	532	1554	...	670	13	6
To employment of labour and payment of wages in July 1938 ...	485	1966	...	743	6	9
To employment of labour and payment of wages in August 1938 ...	456	1856	...	670	8	0
To employment of labour and payment of wages in September 1938 ...	456	2394	...	324	5	3
To employment of labour and payment of wages in October 1938 ...	476	2510	...	846	14	0
To employment of labour and payment of wages in November 1938 ...	463	3003	...	937	7	0
To employment of labour and payment of wages in December 1938 ...	491	2655	...	867	9	9
To employment of labour and payment of wages in January 1939 ...	481	2043	...	733	3	9
To employment of labour and payment of wages in February 1939 ...	446	1599	...	648	3	9
To employment of labour and payment of wages in March 1939 ...	483	3437	...	1,027	13	0
To micsellaneous expenses ...	...	...	...	38	7	6
Total ...	5830	27711	33541	9,674	15	0

Summary of Labour Account April, 1938 to March, 1939.—(*concluded.*)

Items of expense	Permanent man-days	Temporary man-days	Total man-days	Amount Rs.	a.	p.
RECEIPTS						
By use of labour on crop accounts	...	...	28340	7,880	14	6
By use of labour on non-crop accounts	...	..	5201	1,672	10	6
Total ...	...	...	33541	9,553	9	0
Balance, surplus ...	...	...	...	121	6	0

NOTES

Out of the total labour force employed on the farm the permanent (monthly) labour formed 17·4 per cent, and the casual (fortnightly) labour formed 82·6 per cent. But out of the total wages paid, that of the permanent labour constituted 32·2 per cent, whereas that of the temporary labour it was 67·8 per cent. This means that as far as wages are concerned, the permanent labour cost more than twice (230 per cent) than the temporary ones. In other words, this is a difference between skilled and unskilled labour. But the more important point in this connection whether the skilled labour cost more or less per unit of output than the unskilled labour cannot be laid down definitely here. It is open to arguments both for and against.

The figures herewith may be studied in one more way. Out of the total labour force 85 per cent were engaged in work directly connected with actual crop-growing and the rest 15 per cent were required for the jobs which did not have direct relation to crops. This was in shape of labour or service supply to other departments of the Institute, which work together and depend on each other quite a bit.

The rise and fall in the strength of labour can also be very well marked according to the busy and slack periods of farming.

Summary of Bullock Account April 1938 to March 1939

Ref. No. L 6 to 9.

Items of expense.		Quantity Mds. Srs.	Rate per Md.	Amount Rs. a. p.
To grain feeds ...	...	1374 0	...	2,632 1 3
To grinding feeds (855 Maunds)	...	...	...	112 11 9
To wheat bran ...	...	229 20	1 13 0	415 15 6
To oil cakes ...	...	243 10	1 10 0	395 4 6
To salt	...	18 11	2 12 0	50 3 0
To molasses feed mixture	...	162 0	1-9, 1-4	205 6 9
To silage	...	7536 0	...	1,849 1 9
To grasses	...	2343 20	...	241 12 9
To miscellaneous roughage feeds	...	1424 0	...	352 8 9
To water—228170 gallons	...	...	...	171 1 6
To labour man-days ...	1549	...	...	489 5 0
To shoeing cart-bullocks and buffaloes ...	..	...	...	127 12 0
To repairing stanchions and oxen neckbelts ...	...	...	...	27 4 9
To miscellaneous supplies	...	...	...	81 5 9
To medecines ...	...	...	...	22 13 0
To supervision ...	...	...	...	170 0 0
To depreciation ...	...	...	...	210 7 3
Use of barn and stanchions Rs. 5,000 @ 5%	...	...	...	250 0 0
To interest on average inventory Rs. 1,488 @ 5%	...	...	...	74 10 0
Total Receipts ...	...	..	...	7,879 12 9
By bullock labour used on crop-Actts. B. Pair Days ...	3924	...	..	4,905 5 0
By bullock labour used on non-crop Actt ...	2227	...	...	3,170 1 6
By fresh manure ...	..	...	...	400 0 0
By miscellaneous income	...	...	...	8 8 0
Total ...	6151	...	...	8,483 14 6
Balance, surplus ...	...	...	...	604 1 9
Cost per pair of bullocks at work per day (Rs. 7,880 debited by 6151 pairs) ...	...	..	...	1 4 6

NOTES

Of the total cost incurred in the year on account of work bullocks, cost of concentrate feeds forms 49 per cent, cost of roughage feeds nearly 32 per cent, and other costs form about 19 per cent. Molasses feed experiment was conducted with about 10 pairs of bullocks whose concentrate feeds cost more than otherwise.

We have had 25 to 26 pairs of oxen throughout the year. This means that of the total number of bullocks, fed and maintained in the year, about 66 per cent actually worked. We have Sundays holidays for the workmen as well as for the work oxen. Then the oxen also stay back from work due to sickness, physical injury, weather, festivals, and non-provision of work in slack seasons. However, sixty-six per cent employment of bullocks is, I believe, quite satisfactory.

Summary of Equipment (Implements) Account, April 1938 to March, 1939

Ref. No L. 15.

Items of expense	Equip. days	Rate at		Amount Rs. a. p.
To repairs of U.P. ploughs-rooters	...	...	...	111 3 0
To repairs of mould-board ploughs ...	...	...	...	176 10 3
To repairs of harrows ...	...	...	...	89 15 3
To repairs of bullock-cultivators	...	..	...	9 7 0
To repairs of seed-drills ...	...	...	...	32 1 0
To repairs of yokes ...	...	...	...	14 9 3
To repairs of scrapers ...	...	...	...	21 10 6
To repairs of miscellaneous equipments ...	...	...	...	29 3 9
To cleaning of equipment	...	...	...	0 12 0
To depreciation 38-39 ...	...	...	...	335 5 0
To interest on average inventory Rs. 2,429 at 5%	...	...	...	121 7 0
Total Cost ...	...	...	...	942 4 0
RECEIPTS				
By the use of U.P. plough-rooters	325½	0 5 0	...	100 9 6
By the use of mould-board ploughs	1676½	0 3 0	...	296 8 0
By the use of harrows ...	435½	0 4 0	...	106 15 0
By the use of bullock cultivators	165½	0 4 0	...	39 6 0
By the use of seed-drills and W. W. plough-seeders	76 86	1 0 0 0 2 0	...	85 12 0
By the use of scrapers ...	1054	0 2 0	...	110 5 6
By the use of miscel. equipments	46½	...	...	13 6 0
Total ...	3865½	...	...	752 14 0
Balance, deficit ...	...	...	...	189 6 0

NOTES

The expenses on account of yokes, chains, ropes, neck-belt etc, are recovered through the charges of implements. Some are recovered through the charges of oxen.

The U.P. plough No. 2 is used on the farm for hot weather ploughing. The shares (rooters) are sharpened almost daily, which becomes expensive enough.

The use of implements, as seen herewith, costs a lot, which may look contrary to general impression. But the fact is there. The implements also cost quite a bit in addition to man and bullock work in the cost of production of crops.

Summary of Equipment Account, April, 1938 to March, 1939

(*Bullock-Carts*)

Ref. No. L. 20.

Items of expense	Cart-day	Rate			Amount		
					Rs.	a.	p.
To all kinds of repairs on carts and grease.	...	...			503	14	9
To depreciation—1938-39 ...	...	...			443	8	0
To interest on average inventory Rs. 1,620 at 5 per cent ...	...	...			81	0	0
Total cost ...	...	...			1,028	6	9
RECEIPTS							
By the use of big carts (2 bullocks)	1144	0	10	0	715	0	0
By the use of *ekki* carts (1 bullock)	923	0	6	0	346	2	0
By the use of *thela* carts ...	148	0	2	0	18	4	0
By the use of water cart ...	32	0	1	0	2	0	0
Total ...	...	...			1,081	6	0
Less given credit to S.S. A/c ...	...	...			101	5	6
Total ...	2247				980	0	6
Balance, deficit ...	...	...			48	6	3

NOTES

Many of the bullock carts have pneumatic tyres and expensive body also. Their maintenance is more expensive than that of the iron wheel carts. However, the pneumatic tyred carts carry much heavier loads with comparatively more comfort for oxen and buffaloes. Hauling of crops from fields has been very greatly facilitated by pneumatic tyred carts.

Summary of Juar* Account 1938-1939.

Ref. No. L. 55, 57. Area 84·43 acres { Irrigated 57·38 acres. Unirrigated 27·05 acres.

Items of expense		Man-days	Bullock pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To manuring and sheep folding ...		...	...	...	...	191	0	0
„ manure								
„ preparatory tillage	Dry weather ploughing	192	190	R.	95	331	13	6
	Tractor discing ...	...	...	...	...	...		
	Other bullock operations	165	154½	I.	154½	269	7	0
„ sowing by harrows and drills ...		125	92½	H.D.	92½	180	5	6
„ seed 36 maunds 8 srs. @ 2/12/per maund ...		...	...	...	...	77	0	0
„ irrigating and irrigation-furrows ...		296	9½	P.	9½	108	12	0
„ irrigation-water ...		...	...	...	...	255	0	0
„ weeding F. 17, 20 ...		67	...	...	...	19	0	0
„ cultivating F. 11 drilled ...		5	2½	Cl.	2½	5	5	0
„ harvesting and Hauling fodder ...		1657	35¾	C.	78½	541	1	0
„ plucking heads ...		64	...	...	...	15	0	0
„ threshing heads ...		9	12	...	...	17	8	0
„ watching general and (brids-65½-15)...		279	...	...	...	82	0	0

*Andropogon sorghum

Summary of Juar Account 1938-1939.—(*concluded.*)

Items of expense	Mandays	Bullock pair days	Equipment kind	Equipment days	Cost Rs	a.	p.
To hauling some fodder to market ...	338	84¼	C.	168½	241	5	0
„ marketing of fodder ...	...	...	...	...	98	15	0
„ supervision ...	...	...	...	...	399	10	0
„ hauling husks (Bhusa) ...	2½	½	C.	1	1	10	6
„ store expenses ...	...	...	...	...	12	8	6
„ interest on Rs. 1,687 @ 5% for 4 ms. ...	...	...	...	...	28	2	0
„ use of land ...	...	...	...	...	503	0	0
Total	3199½	581½	...	602	3,378	6	6
Per acre ...	38	7	...	7	40	0	0

Receipts	Yield Number	Yield Mds.	Yield Srs.	Rate	Value Rs.	a.	p.
By green fodder ...	...	25209	...		5,470	1	0
„ dry „ ...	...	2300	...		816	0	0
„ grains ...	...	65	28		131	15	3
„ grain husk (bhusa ...	...	36	...		11	0	0
Total ...	...	...	...		6,429	0	3
Per acre ...	...	...	...		76	2	3
Balance, surplus ...	...	...	...		3,050	9	9
„ per acre ...	...	...	...		36	2	3

NOTES

All the irrigated area plus a little (1·62 acres) of the unirrigated area that is, altogether 59 acres, was under fodder *juar*. One acre of the unirrigated area was Imphi *juar* and the remaining area, that is, 24·43 acres was under, so to say, grain *juar*. Nineteen acres of the unirrigated area had mixed crops *juar* and *arhar* all over 19 acres, out of which on 15 acres there was *mung* and the remaining 4 acres it was soybean.

The area of 19 acres of mixed crops mentioned above had compost manuring and 9 acres of this had sheep folded on it as well. Out of the total cost of this compost manuring and sheep folding Rs. 191 as shown on the back was charged to *juar* and the rest to *arhar*, *mung* and soybean. The irrigated area did not have manuring this year but it did benefit a lot by the manuring done for and charged to last potato crop.

Average yield of green fodder comes to about 427 maunds per acre and its average value to about Rs. 93 per acre. The average yield of dry fodder works out to about 92 maunds per acre. The grain did not come, strictly speaking, from all about 25 acres. But however, taking it as all right for practical purpose the average grain yield per acre comes to 2 mds. 24 srs. The average gross value of dry fodder, grain, and bhusa comes to about Rs. 38-6-0 per acre which, I think, is not very bad in comparison to fodder *juar* which largely comes from doubly or tribly rich and irrigated fields. The accounts of *arhar* and *mung* should also be considered along with this.

A very little area of *juar* was drilled this year probably for the first time. It did not give higher yield than the broadcast fodder. However, we will try it further and will be able to say more about it next year.

Out of the total quantity of *juar* fodder (27509 maunds) about 7000 maunds were sold in the city for Rs. 2,000. The rest was used on the farm. The marketing expense was Rs. 340 which is 17 per cent of the total value of fodder sold. Calculated in another way the cost of marketing comes to between 9 and 10 pies per maund of fodder sold.

If we deduct the value of grain from the total cost, the cost of production per maund of fodder (both dry and green) comes to about 1 an. 9 pie. excluding interest and charge for the use of land.

Summary of Bajra* for Grain Account—1938-1939

Field No. Ind. S. Paddock S., Siding. Area 96·00 acres unirrigated.

Ref. No L. 52.

Items of expense	Man-days	Bullock pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To sheep folding Bara S.	...	...	...	...	28	0	0
To preparatory tillage { Dry weather ploughing	196	196	R-G	124	339	10	0
To preparatory tillage { Tractor discing	50	...		9	191	12	6
To preparatory tillage { Other bullock operations	173	173	I	173	306	2	6
To sowing	119	77	H	77	151	4	0
,, seed 7 mds. 8½ seers...	...	...	...	...	17	9	0
,, cultivating ...	45	45	W.W.C.	45	82	7	0
,, harvesting and hauling both grain and stover...	778	26	C	34	242	8	0
,, threshing ...	184	130	...	...	210	0	0
,, watching ...	557	...	...	...	147	14	0
,, hauling	10	2	C	4	7	3	6
,, supervision ...	...	...	...	...	262	0	0
,, storing expense ...	44	...	...	...	10	11	0
,, interest on Rs. 911 at at 5 % for 4 mos. ...	...	...	...	...	15	3	0
,, use of land ...	...	...	...	...	310	0	0
Total ...	2156	649	...	466	2,322	4	6
Per acre	22	6·8	...	4·8	24	3	0

*Pearl millet—Pennisetum typhoideum.

Summary of Bajra for Grain Account 1938-1939.—(*concluded.*)

Receipts.		Yield			Rate.			Value.		
		Number.	Mds.	Srs				Rs.	a.	p.
By bajra grain	...	...	363	18	2	7	0	888	14	9
„ bajra stover	...	...	3092	10	0	3	3	627	15	9
„ bajra husk	...	...	200		...			53	0	0
Total	...	...	...	...	...			1,569	14	6
Per acre ...	...	...	...	...	...			16	5	0
Balance, deficit	...	...	...	...	...			752	6	0
„ per acre	...	...	...	..	...			7	14	0

NOTES

Bajra is sown mixed with *arhar* and *mung* seeds. As such, it is impossible to record the cost of each crop separately. However, they have been accounted for separately as far as it was practicable. Except those items of cost which could be attributed to *arhar* and *mung*, all the items of cost have gone to the *bajra* crop.

The most expensive item, as seen on the back, was seed bed preparation which forms 36 per cent of the total cost. Then comes the items of harvesting and threshing. Harvesting comes to about Rs. 2-9 per acre, or about 13 maunds of stover per rupee. Threshing comes to Rs. 2-3 per acre, or about 0--9-3 per maund of grain threshed.

The average yield of dry fodder works out to about 32 maunds per acre and its value to Rs. 6-9. The average yield of grain works out to nearly 4 mds. and the value of Rs. 9-4-3 per acre. The average gross value of Rs. 16-5 as seen on the back is about 42 per cent of that obtained from dry *juar* crop. While both the yields and the value of *bajra* grain are higher than those of *juar*, the yield and value of stover of the former are only about one-fourth of the latter.

The sheets on *arhar* and *mung* should also be considered along with this.

Summary of Arhar* Account 1938-1939

Field No. Bara S. Ind S., Siding. Area 114·00 acres unirrigated.

Ref. No. L. 59, 102.

Items of expense	Man-days	Bullock-pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To share of manuring in *juar* ...	...	...	...	...	60	0	0
„ seed 14 mds. 5 srs. @ 3 per maund ...	...	...	...	...	43	2	0
„ making fire against frost ...	4	...	...	...	1	0	0
„ harvesting and hauling ...	307½	10	C.	10	114	12	0
„ threshing ...	338½	2½	...	...	91	0	6
„ watching and rat control ...	100	...	...	...	31	0	0
„ binding stalks into bundles ...	20½	...	...	..	5	2	0
„ basket making ...	159	...	...	...	43	2	0
„ supervision ...	...	...	...	...	140	8	0
„ interest on Rs. 511 @ 5% for 5 mo. ...	...	...	...	...	10	14	0
„ use of land ...	...	...	...	...	135	0	0
Total ...	929½	12½	...	10	674	8	6
Per acre ...	8	...	...	...	5	14	6

*A pulse crop, Cajanus indicus.

Summary of Arhar Account— 1938-1939.—(*concluded.*)

Receipts		Yield		Rate	Value		
	Number	Mds.	Srs.		Rs.	a.	p.
By arhar grains ...	...	149	33	...	468	8	6
„ „ bhusa ...	...	399	...	...	199	8	0
„ „ stalks ...	266	...	...	...	65	15	0
„ „ „ baskets ...	401	...	...	...	33	7	6
Total ...	...	...	...	...	767	7	0
Per acre ...	...	...	...	...	6	11	9
Balance, surplus ...	...	...	...	...	92	14	6
„ per acre ...	...	...	...	...	0	13	3

NOTES

Arhar is a crop sown mixed with unirrigated *bajra* and *juar*. It was 95 acres with *bajra* and 19 acres with *juar*. So its cost of seedbed preparation and sowing is borne by those two crops.

It is practically one year's crop and fits in quite well as a catch crop with *bajra* which is generally sown on unirrigated poor land. Occupying the land for such a long time, it naturally has to bear rather a high share of cost of supervision, though it is not high when calculated on the acre basis. Excepting that, harvesting and threshing together form the major part of its total cost of production. However, on acre basis these costs also seem to be quite reasonable.

Summary of Mung* Account 1938-39

Ref. No. L. 60. Area 110·00 acres unirrigated.

Items of expense	Man-days	Bullock pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To share of manuring in *juar*					39	0	0
„ seed 2 maunds and 6 seers	...	...	...	...	8	1	0
„ harvesting and hauling	251	5¾	C.	6	75	12	0
„ threshing ...	78	18	...	...	43	10	0
„ storing	4½	...	...	...	1	4	0
„ hauling husk ...	2½	½	C.	1	1	10	6
„ hauling to market ..	½	¼	C.	½	0	9	0
„ marketing ...	...	...	...	...	2	10	9
„ Supervision ...	...	...	...	...	41	11	0
„ interest on Rs. 189 @ 5% for 3 mo. ...	...	...	...	...	2	6	0
„ use of land ...	...	...	...	...	50	0	0
Total ...	336½	24½	...	7½	266	10	3
Per acre	3	...	...	...	2	6	9

Receipt	Yield Number	Yield Mds.	Yield Srs.	Rate	Value Rs.	a.	p.
By mung (Grain) ...	...	33	20	...	116	11	0
„ straw	...	22	...	...	11	0	0
Total ...	...	...	...	...	127	11	0
Per acre	...	...	...	...	1	2	6
Balance, deficit ...	...	...	...	...	138	15	3
„ per acre ...	...	...	...	...	1	4	3

NOTES

Mung was sown mixed with *bajra* and *juar* as main crops. With *bajra* it was 95 acres, and with *juar* 15 acres. So part of the cost of growing *mung* is borne by *bajra* and *juar*.

While *mung* has fetched a very good price, its yield was so low that it was not paying. It barely paid back its cost of harvesting and threshing. However, its fertilizing value is an important point in its favour.

* A pulse crop. Green gram. Phaseolus radiatus Linn.

Summary of Guara* (Cyamopsis psoralioides) Account 1938-1939

Field No. 1, 10, Ind. S. Abhai. land. Area 19·18 acres unirrigated.

Ref. No. L. 62.

Items of expense.		Man-days	Bullock-pair days	Equipment		Cost		
				kind	days	Rs.	a.	p.
To preparatory tillage	Dry weather ploughing	42	42	R.	21	73	11	0
	Other bullock operations	51	46	I.	46	82	3	0
„ sowing ...		50	32	H.	32	64	12	0
„ seed 13 maunds 15 srs. @ 1-12-0 ...		...	...	...	...	23	6	6
„ weeding ...		142	...	...	...	36	8	0
„ harvesting and hauling ...		134	3	C.	3	43	0	0
„ threshing ...		116	80	...	...	133	6	0
„ hauling (*bhusa*) ...		3	½	C.	1	1	10	6
„ Supervison ...		...	...	...	...	67	0	0
„ interest on Rs. 142 @ 5% for 3 mo. ...		...	...	...	...	1	12	6
„ use of land ...		...	...	...	...	80	0	0
Total ...		538	203½	...	103	607	5	6
Per acre ...		28	10	...	5	31	9	9

*Cluster bean. Cyamopsis psoralioides

Summary of Guara (Cyamopsis psoralioides) Account 1938-1939.—(*concld.*)

Receipts	Yield			Rate	Value		
	Number	Mds.	Srs.				
					Rs.	a.	p.
By green fodder F. 1 4·7 acres ...	...	1559	...	...	308	9	0
„ grains 10·58 acres ...	...	53	23	...	95	14	6
„ *bhusa* ...	...	30	...	...	15	0	0
Total ...	...	...	...	...	419	7	6
Per acre ...	...	...	...	...	21	14	0
Balance, deficit ...	...	...	...	...	187	14	0
„ per acre ...	...	...	...	...	9	11	9

NOTES

The field No. 1 slopes down the Jumna. As such, it is subject to erosion by fast run off of rain water and to inundation when the river rises up. *Guara* is sown here on the upper part of the field because it helps to control erosion when it rains and also when the flood recedes if the field is flooded over. In addition to doing this it also gives green fodder, if not flooded, and acts as green manure, if flooded. The part of the field where *Guara* was sown measured 4·7 acres and gave an yield of green fodder of 1559 maunds, which works out to 332 maunds per acre. In this case the income works out to Rs. 65-10-0 per acre.

The remaining area (14·48) was under *Guara* for grain. This is unirrigated light poor soil. Out of this 3·9 acres entirely failed to grow. So the grain crop was harvested from 10·58 acres only which comes to 5 maunds 4 seers of grain per acre and the value of both grain and straw to about Rs. 10-8-0 per acre. There was a lot of stuff much coarser than *bhusa* which was used for bedding for oxen. This stuff was not weighed and valued.

Threshing is the most expensive operation, which alone exceeds the entire value of the grain crop.

The yield of grain per acre is not very unsatisfactory considering relevant factors. The rate (Re 1-12-0) at which the grain has been valued is arbitrary as it has no market in this area. Its price at the above rate is much less than that of gram but its feeding value for stock seems to be equal to that of gram. It has its fertilizing value also.

Summary of Maize* Account 1938-'39

Field No. 13, 6, 12, 16 Up. 19. Area 10·00 acres, { Irrigated 7·40; Unirrigated 2·60
Ref No. L 53, 54

Items of expense	Man-days	Bullock pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To preparatory tillage, other Bullock operations	28½	28	P. H	28	50	6	0
„ sowing	16	7	P. H	7	15	1	0
„ seed 2 maunds 20 seers	...	...	...	...	10	0	0
„ irrigating ...	49	½		½	16	5	6
„ irrigation-water ...	...	...	...	...	46	0	0
„ weeding F. 6, 16 Up ...	141	...	...	...	39	8	0
„ cultivating and earthing-up F. 6, 12 ...	5	2½	Cul.	2½	5	6	0
„ plucking ears ...	50	...	...	...	13	5	0
„ harvesting and hauling stover	102	¾	C.	1	29	15	0
„ watching field ...	155	...	...	...	41	10	0
„ hauling to market ears 25/4/6; stover 10/ ...	61	7¾	C.&T.	48	35	4	6
„ marketing ears 26/4/3; stover 4/11/9 ...	...	...	...	...	31	0	0
„ supervision ...	...	...	...	...	75	14	0
„ interest on Rs. 293 @ 5% for 2 mos.... ...	...	...	...	...	2	7	0
„ use of land ...	...	...	...	...	90	0	0
Total ...	607½	46½	...	47	502	2	0
Per acre	61	5	...	5	50	3	6

Receipts	Yield Number	Yield Mds.	Yield Srs.	Rate	Value Rs.	a.	p.
By weeds	...	...	...	...	2	8	0
„ maize ears ...	...	...	...	...	294	2	6
„ maize stover ...	...	1381	20	3·32	286	11	0
Total ...	...	...	...	...	583	5	6
Per acre		138	6	...	58	5	3
Balance, surplus ...	...	...	...	...	81	3	6
„ per acre ...	...	...	...	...	8	1	9

* *Zea mays.*

NOTES

Irrigated maize crop is sown mostly on the vegetable area. As such, this crop is greatly benefitted by manuring and cultivation done for the previous vegetable crops.

In the case of maize watching is a very important and costly affair. With strict watching even, parrots take considerable toll of the green ears. Sometimes parrots become a limiting factor in growing maize. Parrots and crows in daytime and jackals at night are serious pests for maize. Jackals and porcupines have been considerably reduced now from the previous years by the use of Cyanogas dust.

Field No. 16 Up (2·60 acres) and No 19 (1 acre) were practically failures. The former was unirrigated and its gross income was Rs.20-5-0 only. It produced no ears and the crop was quite patchy and stunted. Unfavourable soil and weather were the chief causes. The latter, though irrigated, gave a return of Rs. 15-8 only. It was sown late and the soil was also unsuitable. Field No 12 (2·23 acres) also was not quite satisfactory. While it made up its income in fodder (460 maunds Rs. 93-7-0), it was poor in the yield of ears which was worth about Rs. 32 only.

Other plots in No. 13 and 6 (4·17 acres) were much better. Ears were worth Rs. 256 and stover was 775 maunds worth Rs. 164. The average return of these plots (Rs. 100 per acre) works out to about double of the 10 acres average (Rs. 58) as shown on the back.

While the yield of stover is known, it is regretable that the yield of ears, either in number or in weight, is not known. So the yield of grain cannot be estimated. The seed ears, reserved for seed, were only part of the ears' crop of a plot.

Out of the total amount of ears which was worth Rs. 294 an amount worth Rs. 30 only was used on the farm. This shows that maize ears are a very good marketable commodity. The marketing expense amounts to 20 per cent of the value of the ears sold. Stover was sold for Rs. 63 on which the marketing expense is about Rs. 15 which is 24 per cent.

Summary of Paddy* Account, 1938-1939

Field No. 15 Area 2·30 Acres Irrigated.

Ref. No. L. 58

Items of expense	Man-days	Bullock-pair days	Equipment		Cost		
			kind	days	Rs.	a.	p.
To sowing ...	6½	6	P & H	6	11	2	0
" seed 1 maund 37 srs. @ 1-10 per maund ...	...	...	...	...	3	2	0
" irrigating ...	32	...	...	...	9	9	0
" irrigation-water ...	...	...	...	...	12	0	0
" weeding ...	217	...	...	...	60	0	0
" harvesting and hauling ...	29	¾	C.	1½	10	7	0
" threshing ...	16	8	...	...	14	6	0
" watching ...	8	...	...	...	2	2	0
" Supervision ...	...	...	...	...	38	9	0
" interest on Rs. 131 @ 5% for 2 mo. ...	...	...	...	...	1	2	0
" use of land ...	...	...	...	...	45	0	0
Total ...	308½	14¾	...	7½	207	7	0
Per acre ...	134	6	...	3	90	0	3

*Oryza sativa L.

Summary of Paddy Account, 1938-1939—(*Concluded.*)

Receipts		Yield			Rate	Value		
		Number	Mds.	Srs.				
						Rs.	a.	p.
By paddy	...	...	1	14	...	2	11	3
„ paddy straw	...		16	...	...	26	2	0
„ paddy weeding	...	...	...	...	...	22	8	0
Total	...	...	...	...	...	51	5	3
Per acre	...	...	...	...	...	22	5	0
Balance, deficit	...	...	...	...	...	156	1	9
„ per acre	...	...	...	...	...	67	11	3

NOTES

The purpose of growing paddy on the Institute farm has been for students to get familiar with the crop. There is no suitable land for paddy on the farm. Sullage irrigation proves still worse for it. Under such conditions a loss under this crop is not at all surprising. Weeding was the most expensive operation.

Summary of Sannhemp* for seed Account, 1938-1939.

Field No Ry. Siding land. Area 7·60 acres Unirrigated.

Items of expense		Man-days	Bullock pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To preparatory tillage Other bullock operations	...	18½	18½	P & H.	18½	33	1	0
„ sowing	...	11	8	H.	8	15	8	0
„ seed 7 mds. @ 2/4/- per maund	...	...	...	...	...	15	12	0
„ cutting and retting		18	...	...	...	5	4	0
„ washing and extracting fibre	...	66	...	...	...	18	8	0
„ harvesting and hauling	...	102	5¼	C	6½	36	11	0
„ threshing	...	126	5½	C	2	42	12	0
„ hauling *bhusa*	...	2½	½	C	1	1	10	6
„ watching	...	22	...	...	...	7	0	0
„ supervision	...	...	...	...	...	42	4	0
„ interest on Rs. 164 @ 5% for 4 mo.	...	...	...	...	...	2	12	0
„ use of land	...	...	...	...	...	52	0	0
Total	...	366	37¾	...	36	273	2	6
Per acre	...	48	5	...	5	35	15	0

*Crotalaria juncea.

Summary of Sannhemp for seed Account 1938-1939.—(*concluded.*)

Receipts.	Yield.			Rate.	Value.		
	Number.	Mds.	Srs		Rs.	a.	p.
By sannhemp seeds ...	...	38	7	...	83	10	3
„ „ straw (*bhusa*)...	...	25	...	...	12	8	0
„ „ fibre ...	...	...	...	...	30	0	0
Total ...	...	...	...	...	126	2	3
Per acre ...	...	...	...	...	16	9	6
Balance, deficit ...	...	...	...	...	147	0	3
„ per acre ...	...	...	...	...	19	5	6

NOTES

Sannhemp is sown here on unirrigated poor land. Harvesting and threshing together forms about 30 per cent of the total cost.

The yields of seeds come to about 5 maunds per acre which I do not consider bad in view of the quality of the land on which it was sown. The rate at which the seeds were credited was arbitrary as it is generally not a market commodity here. The rate at which the seeds are credited comes on the average to about Rs. 2-3-0 per maund. I think it was priced lower than what it should have been, that is, Rs. 3 per maund.

The loss excluding interest etc. comes to about Rs. 13 per acre. Its fertilizing value should also be kept in mind. It fertilizes the land both by roots and leaves.

Summary of Soybean* Account 1938-1939.

Field No. 3·9 M. N. Area 7·35 acres unirrigated.

Ref. No. L. 63.

Items of expense	Man-days	Bullock pair-days	Equipment		Cost		
			kind	days	Rs.	a	p.
To manure ...	...	...	...	...	11	0	0
" preparatory tillage Other bullock operations ...	10	7½	P & H	7½	14	7	0
" sowing ...	6	5	P.	5	9	6	0
" seed 1 maund 29 srs. @ 2/10/- per md. ...	...	...	...	...	4	9	0
" weeding F. 9.. 2·6 acres	68	...	...	...	17	8	0
" harvesting and hauling ...	10	...	...	...	2	8	0
" threshing ...	42	24	...	...	41	4	0
" straw hauling ...	2	½	C.	1	1	10	6
" packing ...	6	...	...	...	2	0	0
" supervision ...	...	...	...	...	17	0	0
" interest on Rs. 74 @ 5% for 2 mo. ...	...	...	...	...	0	10	0
" use of land ...	...	...	...	...	21	0	0
Total ...	144	37	...	13½	142	14	6
Per acre ...	20	5	...	2	19	7	3

*Glycine max.

Summary of Soybean Account 1938-1939.—(*concluded.*)

Receipts		Yield			Rate	Value		
		Number	Mds.	Srs.		Rs.	a.	p.
By grain	...	...	12	14	...	78	10	3
„ straw (*bhusa*)	...	...	17	...	...	8	8	0
„ weeds	...	...	40	...	...	4	0	0
Total	...	...	...	...	...	91	2	3
Per acre		...	...	...	...	12	6	3
Balance, deficit	...	...	...	...	...	51	12	3
„ per acre	...	...	...	...	...	7	1	0

NOTES

Out of the total area of 7·35 acres, 4 acres were sown with *juar* and *arhar*. Here the soybean crop was almost nil. The remaining 3·35 acres were sown only to soybean. All the fields under this crop were poor and unirrigated.

The cost of manuring as seen on the back is in way of adjustment for manure applied to *juar* crop on Mahua North field. Threshing seems to be the most costly operation.

Excluding 4 acres with *juar* where soybean did not grow, the yield of grain per acre comes to 3 maunds 27 seers. It is not satisfactory. It is a new crop and needs more trial.

The crop was fortunate in securing a good price for grain by selling most of it outside. Even then the crop shows a loss.

Summary of Early Bajra Fodder Account, 1938-1939, 1939-1940

Field No. F. 16 A. B. and D.

Ref. No. L. 78,110. Area 6·2 acres Irrigated.

Items of expense.	Man-days	Bullock pair-days	Equipment kind	Equipment days	Cost Rs.	a	p.
To sowing	12	5½	H.& W.W.	5½	13	0	0
„ seed 3 maunds and 30 seers	...	...	...	..	7	7	9
„ irrigating ...	47	...	...	..	14	6	0
„ irrigation-water ...	...	...	...	...	60	0	0
„ harvesting and hauling	145	6	C.	6	48	8	0
„ watching ...	35	...	...	...	11	0	0
„ supervision ...	...	...	...	...	35	11	0
„ interest on Rs. 118 @ 5 % for 2 mo. ...	...	...	...	...	1	0	0
„ use of land ...	...	...	...	...	50	0	0
Total ...	239	11½	...	11½	241	0	9
Per acre	38½	...	...	...	38	14	0

Receipts.	Yield Number	Yield Mds.	Yield Srs.	Rate	Value Rs.	a.	p.
By bajra fodder ...	...	3181	20	...	721	7	9
Total ...	...	3181	20	...	721	7	9
Per acre	...	513	...	...	116	6	0
Balance, surplus ...	...	...	...	...	480	7	0
„ per acre ...	...	...	...	...	77	8	0

NOTES

See the notes for 1937-38 for general remarks.

Only the first cut of *bajra* was taken this year, not the second cut, as the fields were prepared for and sown to *juar* fodder immediately. On comparative basis, the yield of early *bajra* this year, on the average, was 513 maunds per acre and the gross income Rs. 116-6 as against 880 maunds and Rs. 198-1-6 last year respectively. This was considerably due to the difference in summer weathers of 38-39 and 39-40, as pointed out in the Weather reports of those years. Then one field (F. 16 B.) was very poor this year and gave only 133 maunds per acre. However, the other two fields were quite good and gave 692 and 668 maunds per acre.

The cost of production per maund of green fodder comes to nearly one anna excluding the charges of interest, and use of land.

Summary of Napier Grass* Account April, 1938—March, 1939

Field No. 23. 7. 22. 15. 11.
fence border.

Ref. No. L. 48, 49.

Area 9·2 Acres { Irrigated 1·3 Acres / Partly irrigated 7·9

Items of expenses		Man-days	Bullock pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To irrigating	...	57	...	...	...	18	3	0
,, irrigation-water	...	...	...	...	...	159	0	0
,, harvesting and hauling	...	965	12¾	C	24	299	10	0
,, watching, share of general	...	30	...	...	...	10	0	0
,, hauling to market	...	94	23¼	C	46½	67	7	0
,, marketing	...	...	...	...	...	28	9	3
,, supervision	...	...	...	...	...	147	1	0
,, digging roots for parcel	...	30	¼	...	½	9	7	0
,, bags and *sutli* for parcel	...	...	...	...	...	2	6	0
,, interest on Rs. 543 @ 5% for 3 mo.	...	...	...	...	...	6	12	6
,, use of land	...	...	...	...	...	200	0	0
Total	...	1176	36¼	...	71	948	7	9
Per acre	...	128	4	...	8	103	0	9

*Pennisetum purpureum.

Summary of Napier Grass Account April, 1938—March, 1939—(concluded).

Receipts	Yield			Rate	Value		
	Number	Mds.	Srs.		Rs.	a.	p.
By green fodder ...	...	18204	...	...	3,977	7	6
„ roots and cuttings for planting ...	...	42	5	...	124	8	6
Total ...		18246	5		4,102	0	0
Per acre ...	...	1983	11	...	445	14	0
Balance, surplus ...	...	...	...	...	3,153	8	3
„ per acre ...	...	...	...	...	342	13	3

NOTES

The different plots under Napier grass are several years' old planting. The oldest is about 9 years. All of them had been sullage irrigated till July 1938, except one in the field No. 15 which measures 1·3 acres and is still sullage-irrigated. All the plots gave two cuttings in the year. This is very much due to our cutting them rather later than sooner for ensiling, The yield of green fodder per acre in the year in different plots was from about 1300 to 2400 maunds. This low yield of 1300 maunds was obtained from Field No. 15 which is on heavy soil and irrigated area. Others which had no irrigation after July but are on lighter soil than F. 15 yielded about twice as much. This shows the importance of the soil factor in the production of Napier grass. However, under the same conditions Napier yields twice as much as Guinea grass. The yields in the rainy season is about two times that obtained in dry season. Nevertheless, out of the total yield of Napier fodder in the year about 60 per cent was obtained in summer.

About 2000 maunds of the total amount of fodder were sold in the city for Rs. 465-8-0. This comes to 0-3-8 per maund on the average. The cost of marketing comes to 9 pies per maund or about 20 per cent of the value of fodder sold. Fodder was charged for farm stock feeding after deducting the excess cost of marketing, which comes to 0-3-5 per maund on the average.

Harvesting forms 40 per cent of the total cost of production excluding interest and use of land. This cost of production comes to about 8 pies per maund of fodder produced.

Summary of Guinea Grass* Account, April 1938—March, 1939

Field No. 23, F. 12 fence border. Area 1.08 Acres Irrigated up to July, '38.
Ref. No. L. 47.

Items of expense.	Man-days	Bullock-pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To irrigating ...	8	...	...	...	2	9	0
„ irrigation-water ...	...	...	...	..	15	0	0
„ harvesting and hauling	108½	...	...	...	30	10	0
„ watching ...	4	...	...	...	1	0	0
„ supervision ...	...	...	...	...	15	1	0
„ interest	...	...	...	...	0	10	0
„ use of land ...	...	...	...	...	25	0	0
Total ...	120½	...	...	...	89	14	0
Per acre	111½	...	...	...	83	5	3

Receipts	Number	Yield Mds.	Yield Srs.	Rate	Value Rs.	a.	p.
By Green cuttings 3 (Fodder)	...	1432	20	...	312	6	3
„ roots for planting ...	...	...	10	...	0	12	0
Total ...	...	1432	30	...	313	2	3
Per acre	...	1326	25	...	289	15	0
Balance, surplus ...	...	...	...	..	223	4	3
„ per acre ...	...	...	...	...	206	9	9

*Panicum maximum.

NOTES

The Guinea grass in Field No. 23 which is one acre, is now 9 years old crop. It had been under sullage irrigation till about the end of July 1938, when sullage supply in that area was cut off by the Allahabad Municipality. The crop gave three cuttings of green fodder in the year. The first cut was in April 1938, yielding 318 maunds and 20 seers, the second in July 1938, yielding 772 maunds and 20 seers and the last one was in November 1938, yielding 308 maunds and 20 seers of green fodder. The last cut was without irrigation. We might have got one more cut before April 1939, had there been irrigation.

A narrow strip of Guinea grass was planted, years ago, beside the fence in Field No. 12, as the strip comes under shade of roadside mango trees. This strip measures 0·08 acre from which we got 33 maunds of green fodder in the year which is not bad.

It being a perennial crop, the cost of production naturally does not come high in its later years of cultivation. Harvesting and irrigation charges form the main items of cost, which together form about 75 per cent of the total cost excluding interest and use of land. The cost of production excluding interest and use of land comes to about 9 pies per maund of green fodder.

On the income side it can be seen that the price per maund of green fodder comes to 3.5 annas which is cheaper than *juar* fodder in addition to its value of supply of green fodder in November and April.

Summary of Barley Fodder Account 1938-1939

Field No. 13
Ref. No. L. 76

Area 3·10 Acres Irrigated.

Items of expense.	Man-days	Bullock-pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To sowing ...	½	1½	H	1½	3	4	0
„ seed 3 maunds ..	...	...	...	...	7	8	0
„ irrigating ..	15½	...	...	...	4	13	0
„ irrigation-water ...	...	...	...	...	9	0	0
„ harvesting and hauling	47½	...	...	...	14	0	0
„ supervision ...	...	...	...	...	8	5	0
„ interest on Rs. 36 @ 5% for 1 mo. ...	...	...	...	...	0	2	3
„ use of land ...	...	...	...	...	15	0	0
Total ...	66½	1½	...	1½	62	0	3
Per acre	21.	...	...	...	20	0	0

Receipts	Yield Number	Yield Mds.	Yield Srs.	Rate	Value Rs.	a.	p.
By green fodder ...	...	448	...	...	103	8	0
Total ...	...	448	...	...	103	8	0
Per acre	...	144	30	...	33	6	3
Balance, surplus ...	...	...	...	...	41	7	9
„ per acre ...	...	...	...	...	13	6	3

NOTES

The part of the field No. 13 in question was used for farmers' ploughing contest during the Farmers' Fair towards the end of February 1939. This had early potato which was dug out in January and the barley seeds were immediately put in for fodder as a catch crop. The crop was only one month in the field and was about a foot high when harvested.

Summary of Grasses Account, April 1938—March 1939

Ref. No. L. 50.

Items of expense.	Man-days.	B. P. days.	Equip.	days.	Rs.	a.	p
To cutting and hauling dub grass ...	242	...	...	...	61	14	0
,, cutting and hauling grass from bunds and grounds ...	1313	4¼	G & C	4½	352	0	0
,, cutting and hauling from Ry. line ...	1018½	20	C	20	290	5	0
,, cutting and hauling grass for sale ...	66	...	...	...	17	8	0
,, marketing expenses on grass sold ..	...	...	...	..	1	13	3
,, contract price for Ry. line grass ...	...	...	...	...	76	3	0
,, watching ...	80	...	...		25	0	0
,, supervision ...	...	...	...	...	365	0	0
,, interest on Rs. 1,289 @ 5% for 3 mo. ...	...	...	...	...	16	2	0
,, use of land ...	...	...	...	...	420	0	0
Total ...	2719½	24¼	...	24½	1,625	13	3

Summary of Grasses Account, April 1938 – March 1939.—(*Concluded.*)

Receipts.			Mds.	Sr.	Rs.	a.	p.
By dub grass ...	...	...	643	...	258	14	0
„ railway line grass ...	...	...	5179	...	845	9	6
„ grass from grounds and bunds ...	...	...	4041	10	469	0	3
„ grass sold in the market ...	...	...	...	...	54	9	9
„ kansa and weeds to outsiders ...	...	...	...	...	30	12	0
„ grazing to Leper Asylum	...	...	...	...	5	0	0
„ excess of cost over value of grass on certain places ...	...	...	...	...	61	5	0
Tetal ...	...	...	9863	...	1,725	2	6
Balance surplus ...	...	...	...	10	99	5	3

NOTES

During the monsoon season grasses grow very fast. They need to be cut so that the premises are kept clean. All the grasses are fed to the farm stock and charged according to their feeding value keeping in mind the market prices as well.

Summary of Berra, Gram, etc., Account, 1938-1939—(*contd*).

Items of expense	Mandays	Bullock pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To watching ...	301	...	...	...	95	0	0
„ hauling to market *bhusa*	80	36	C.	36	90	10	0
„ marketing *bhusa* 30/2/- grain 21/10/9 ...	...	...	...	...	51	12	9
„ supervision ...	...	...	...	...	378	2	0
„ storing grains ...	109	3	C.	6	35	4	0
„ interest on Rs. 2,144 at 5% for 4 mo. ...	...	...	...	...	35	12	0
„ use of land ...	...	...	...	...	430	0	0
Total ...	3286	902	...	877	5,580	14	3
Per acre	27·2	7½	...	7·3	46	4	6

Receipts		Yield mds.	Yield Srs.	Rate Ave. per md.	Value Rs.	a.	p.
By weeds ...	...	...	...	...	4	12	0
„ gram	...	163	23	2/12	463	12	3
„ barley	...	326	36	2/9	836	14	0
„ *berra, gohchani, gojai* ...	...	718	12	2/13	2,021	7	3
„ linseed	...	38	7	4/3	191	15	0
„ all *bhusa* (straw) ...	...	1804	5	...	1,737	0	3
Total ...	...	...	...	...	5,255	12	9
Per acre	...	...	...	...	43	9	3
Balance, deficit ...	...	...	...	...	325	1	6
„ per acre ...	...	...	...	...	2	11	3

NOTES

The details of the area are: Berra (a mixture of barley and gram) 62 acres, gram alone 30·4 acres, barley alone 23·6 acres, *Gohchani* (a mixture of wheat and gram) 4·6 acres. All together they covered 120·6 acres. Linseed was sown all over the area in lines about 6 feet apart. So it may be said to have covered about 20 acres, had it been sown by itself.

Out of the total cost of Rs. 409-9-6 for manure and manuring, green-manuring with sannhemp cost (135-107½-107½) Rs. 253-3-6 and the compost manuring cost Rs. 156-6. The former was done on 30 acres, which works out to Rs. 5 per acre. The latter was done on 4·6 acres (Gohchani) which works out to about Rs. 34 per acre. It is said that green manuring with sannhemp adds 60 pounds of N per acre to the soil. As such, at the above figure it means Re. 1 for 12 pounds of N. If ploughing before sowing the sannhemp seed and the ploughing under are excluded from the cost of green manuring, as fallows for Rabi have to be ploughed twice during the rains even without sannhemp, the cost of green manuring then comes to Re. 1 only per acre. In that case it will be Re. 1 only for 60 pounds of N. A nitrogenous fertilizer, for instance Sulphate of Ammonia, may be compared with this. It may be valued at Rs. 124 per ton containing 20·6 N. In this case it works out to Re. 1 for 3·7 pounds of N. With Castor Cake it will mean Re. 1 per 2 pounds of N. The above figures for compost is for about 50 tons. It will mean Re. 1 for 4 pounds of N.

The details of seeds sown are: Gram 32½ mds., *berra* 57 mds., barley 30 mds., and linseed 11 mds. and 10 seers.

The details of harvesting and hauling: barley (306-4-6)=Rs. 84-12, gram (207-4-5)=Rs. 59-2, *berra* (625-8½-12½)=Rs. 156, *gohchani* (56-1-2)= Rs. 16-8. The cost of harvesting and hauling per acre of the above different grains can be calculated and the difference from the average noted. It can be seen that in order of expensiveness of harvesting barley stands first and gram last, and *berra* in the middle.

The threshing cost of linseed (24½-17)=Rs. 27-12, which was threshed by bullocks comes to Re. 0-11-8 per maund of grain threshed. Other grains which were threshed by thresher cost about Re. 0-10-8 per maund of grain threshed. The additional cost of straw-breaking comes to about Re. 0-4-4 per maund of *bhusa* broken.

The cost of marketing *bhusa* comes to nearly -/1/1 per maund. Rs. 21-10-9 are the part marketing expenses for 294 mds. 20 seers of *berra*, barley, gram and linseed.

The most expensive items of cost in order of their expensiveness are: tillage (33·5%), threshing and breaking (25·4%), seeding (11·6%), manure, supervision, and harvesting between 6 to 8% of the total cost excluding the charges of interest and use of land.

From the areas of different grains given on the top it can be noted that the yield per acre of gram is 5·4 mds, barley 14 mds. and *berra* etc. 10·7 maunds Linseed as a mixture gave only 12·6 seers per acre. Rain in February had told upon gram and linseed quite a bit. Linseed had some disease due to which at many places linseed was left in bare stalks.

On the whole the position has not been unsatisfactory. If these crops have not gained, they have hardly lost much in spite of bearing quite a large part of total farm expenses.

Summary of Early Potato Account, 1938-1939

Field No. 12, 13, 16, 17. Area 13·00 Acres. Irrigated.

Ref. No. L. 67.

Items of Expense	Mandays	Bullock pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To manuring } F. 13, 16, 12 „ manure }	..	...	...	...	269	15	0
„ preparatory tillage—							
Tractor discing F. 13	...	...	...	...	6	8	0
Other Bullck operations	125	108¼	I	107	195	9	0
„ sowing ...	78	13	Cul.	13	42	8	0
„ seed 60 mads. 20 srs. for 672-1-6 plus haulding and cleaning seed.	75	½	C	½	694	0	6
„ irrigating ...	144	1½	P	1½	49	2	6
„ irrigation-water ..	...	...	...	...	450	0	0
„ weeding by spike-tooth harrowing ...	3	2½	H	2½	4	8	0
„ cultivating and earthing-up ...	199	23	Cul.	23	87	4	0
„ harvesting and hauling	573	...	...	...	150	0	0
„ watching ..	69	...	...	...	21	0	0
„ hauling to market ...	74	7¼	C.	12½	36	8	0
„ marketing labour and cash ...	60	...	...	...	368	15	9
„ supervision ...	...	...	...	...	180	4	0
„ interest on Rs. 1,910 at 5 @ for 3 mo. ...	...	...	..	...	23	14	0
„ use of land ...	...	...	...	...	210	0	0
Total ...	1400	156	...	160	2,790	0	9
Per acre	108	12	...	13	214	10	0

Summary of Early Potato Account—(*contd*).

Receipts	Yield			Rate	Value
	Number	Mds.	Srs.		
	Standard Maund				
By potato tubers—1492 mds. @ 54 srs. md. or *Mandi* Maund ...	...	2014	...	...	Rs. a. p. 3,118 5 3
By potato vines ...	...	...	...	...	19 1 6
Total ...	... ...	2014	...	...	3,137 6 9
Per acre ...	...	155	...	...	241 5 6
Balance, surplus ...	...	...	...	...	347 6 0
Balance per acre ...	...	...	...	...	26 11 6

NOTES

Potato growing is very costly. Its high labour requirement is remarkable. Seed is the most expensive item which alone comes to more than Rs. 50 per acre. Manuring done for potato is not all utilized by it. Other crops following it derive considerable benefit from potato manuring. But this frequent and heavy manuring helps to keep the vegetable area in a high state of fertility which is absolutely essential for a potato crop and the like. While it is so expensive to grow potato, it means that it bears a very high percentage of the farm expenses as a whole and in addition pays it back with a fair amount of net profit. Gourds and pumpkins are taken as catch crops with potato.

Besides irrigation, marketing is another outstandingly expensive item. The figure of Rs. 36-8-0 does not represent the full cost of hauling potato to market, as in January and February 39, potatoes were hauled by carts on their way to hauling bricks. So cartage for this period was charged to brick hauling. This cost otherwise would have amounted to about Rs. 45 more. The figure of Rs. 368-15-9 represents the charges of octroi, cart pass, khonchi, commission, and allowance to cartmen attending to the sales. We can see from the figures that it costs about Re. 1 per maund to grow potato, about 4 as. per maund to sell it, and 4 as. per maund is the saving, excluding the charges of interest and use of land.

The average yield of early potato comes to 155 maunds per acre. But there are variations. Field No. 17 was completely spoiled by rain. It produced only 7 maunds. Field No. 16 yielded 154 maunds per acre, Field No. 13—176 maunds and Field No. 12 yielded 222 maunds per acre. But this order changes in regard to gross income. Field No. 16 gave Rs. 244, F. 12 Rs. 293 and F. 13 Rs. 303 per acre. This was because most of the Field No. 13 was sold early in January, while the rest were sold later in January and February.

Summary of Hill Potato Account, 1938-1939

Field No. 11, 16, 17, 22. Area 9·75 Acres Irrigated.
Ref. No. L. 71, 72, 106.

Items of expense.	Man-days.	Bullock-pair-days.	Equipment kind	Equipment days	Cost Rs.	a.	p.
To manuring, „ manure ...	...	...	...	...	107	6	0
„ preparatory tillage: tractor discing ...	...	...		...	42	0	0
„ preparatory tillage: other Bullock operations	36	35½	I	36	63	0	0
„ sowing ...	134	11¼	Cl	12	54	12	0
„ seed 77 maunds ...	...	...	...	...	475	12	6
„ irrigating ...	116	...	...	...	34	4	0
„ irrigation-water ...	...	...	..	...	339	0	3
„ weeding ...	2	...	...	...	0	10	0
„ cultivating and earthing-up ...	172	21½	Cl.	12½	80	0	0
„ harvesting and hauling ...	451	..	...	...	113	8	0
„ watching ...	73	...	...	...	22	1	0
„ hauling to market ...	70	24¼	C	42	63	12	0
„ marketing ...	...	..	...	...	240	3	3
„ supervision ...	...	...	...	...	132	0	0
„ interest on Rs. 1,284 @ 5 %. for 3 mo. ...	...	...	...	...	16	1	0
„ use of land ...	...	...	...	...	155	0	0
Total ...	1054	92½	...	111½	1,939	6	0
Per Acre ...	108	9·5	...	11·5	198	14	0

Summary of Hill Potato Account, 1938-1939.—(*Concluded.*)

Receipts.	Yield. Number.	Yield. Mds.	Yield. Srs.	Rate.	Value. Rs.	a.	p.
		Standard					
By hill potato 1211 mds. pucca	...	1635	...	...	2,466	6	9
,, hill potato vines ...	...	...	...	...	5	8	9
Total ...	...	1635	...	...	2,471	15	6
Per acre ..	...	167	27	...	253	8	9
Balance, surplus ...	...	...	...	...	532	9	6
,, per acre ...	...	...	...	...	54	10	9

NOTES

Costs per acre works out to :—

	Rs.	a.	p.	
Manuring	26	14	0	applied in 4 acres.
Tillage	10	12	3	
Seed and sowing ...	54	6	7	
Irrigation	38	4	6	
Cultivating, etc. ...	8	4	3	
Harvesting	11	10	3	or 1 as. per standard md. of potato.
Marketing	31	3	0	or 3 as. per standard md. of potato.

The yield of potato was from 100 to 188 maunds per acre.

Hill potato paid better than early potato this year.

About 1·5 acres of the crop had pumpkin also.

Summary of Pumpkin*, Gourd*, and Melon* Account, 1938-1939

Field No. 12, 13, 16, 17. With potato Area 8·27 Acres Irrigated.

Ref. No. L. 73, 107.

Items of expense.	Man-days.	Bullock-pair-days.	Equipment. kind.	Equipment. days.	Cost. Rs.	a.	p.
To manuring, „ manure ...	...	...	...	...	101	0	0
„ sowing	2	½	W.W.	½	1	5	0
„ seed melon 6 seers ...	...	...	...	...	6	1	6
„ irrigating ...	50½	...	...	..	15	2	6
„ irrigation-water ...	...	...	...	...	72	0	0
„ cultivating and earthing-up ...	7	3½	Cl.	3½	7	7	0
„ harvesting and hauling	98	...	...	...	23	5	6
„ watching ..	45	...	...	...	14	2	0
„ hauling to market ...	21+	4¾	C.	9	24	3	0
„ marketing ...	2+	...	...	...	56	5	0
„ supervision ...	...	...	...	...	30	5	0
„ interest on Rs. 263 @ 5 % for 3 mo. ...	..	...	...	..	3	4	6
„ use of land ...	...	...	...	..	35	0	0
Total ...	225½	8¾	...	13	389	8	6

*Cucurbita pepo. Lagenaria vulgaris. Citrullus vulgaris.

Summary of Pumpkin, Gourd, and Melon Account, 1938-1939 —(*Concluded.*)

Receipts.		Yield.			Rate.	Value.		
		Number	Mds.	Srs.		Rs.	a.	p.
By pumpkin	...	...	...	...	...	331	3	0
„ gourd	...	...	...	...	...	179	8	0
„ water-melon	...	...	...	...	...	45	7	6
Total	...	...	...	...	...	556	2	6
Balance, surplus	...	...	...	...	...	166	10	0

NOTES

See the special note on Vegetables

Details of acreage :—

PUMPKIN.

	Acres	
F. No. 13	2·56	with Early potato.
F. No. 16	1·25	„ „ „
F. No. 17	1·50	„ Hill „
F. No. 2	6·00	„ Wheat unirrigated
	11·31	

GOURD.

	Acres	
F. No. 12	2·01	with E. Potato.
F. No. 17	0·95	„ „ „
F. No. 2	6·00	„ Wheat unirrigated.
	8·96	

Water melons with unirrigated wheat about 6 acres.

In the wheat area the rows of pumpkins, gourds, and watermelons alternated with each other about 6 ft. apart.

Such a division of acres of these vegetables makes it difficult to calculate the worth of each per acre. It was not recorded as to how much was harvested and sold from the potato and wheat area separately. Taking the figures of area as they stand above, the income works out to about Rs. 29-5 per acre from pumpkin, Rs. 20 per acre from gourd, and Rs. 7-9-3 per acre from melons. The pumpkins and gourds grown in potato fields were certainly yielding far more than those grown in wheat fields. Anyway, even these figures go to prove that pumpkin is much more paying than gourds, which fact is borne out by experience also. Melons paid something this year but most of the years they have been a failure rather than a success. We do not know their yield either in weight or in number, which would have been very interesting to know.

A considerable part of their expenses was borne by potato and wheat. The cost of manuring as shown is a share of the manuring done for potato and wheat. For instance, Rs. 80 is charged for the share of manuring to pumpkin and gourd in F. 12, and 13, and Rs. 13 to pumpkin with wheat, and Rs. 8 to melons with wheat.

Figures per acre have not been worked out owing to the difficulty in acreage as mentioned above.

Special Note On Vegetables Other Than Potato 1938-1939.

There are certain general remarks which hold true of all the vegetables grown on the farm except potatoes. The first thing is that their costs of production are not quite complete in the correct sense. They lack in items, in labour shown, and consequently in amount. The areas under these vegetables are small. Many operations take only hours, even less than an hour. Many such small operations may be done between operations for other crops; many are done at about the close of the day. For instance, transplanting of vegetable seedlings is generally done in the evening. At the close of the day some labourers working elsewhere on the farm may turn in a few minutes earlier than others. Such labourers do this job occasionally just by the way, which does not take often more than half an hour or so at a time.

As such, in some account sheets for these vegetables, the item of seed-bed preparation may be missing, in others sowing or transplanting, and so on, may be missing. In cases where home seeds might have been used, the item of seed may also be missing or only partially entered. Plucking and marketing, etc., are adjusted among these vegetables at the end of the season mainly according to the amounts sold for each. In a part of the day many vegetables may be plucked in varying quantities and sold the next morning. As such, it is practically impossible to record the labour and cost separately for each.

If I may express correctly I would say that in farming business there is not only economics of the season and weather but even of the hour. Many things are done on the farm during such hours which can hardly be accounted for. This fact is hard to explain but easy to understand for those who may have practical experience in the field work. So while for absolute accuracy I cannot claim completeness of the cost of growing these vegetable crops, I do claim very fair correctness for these figures in the practical sense. As such, they furnish valuable information.

On the side of returns, I could give only the money-income, not the yield. This is because the vegetables except potatoes were not weighed or counted. One of the most important problems about vegetable culture is to be able to know the difference between total amount of fruiting and the harvesting, and the total amount harvested and the amount sold. In other words, it means the percentage of loss in the field and the percentage of loss in handling. Without these considerations and information, calculations of crop incomes are likely to be placed far higher than their practical limits. From next year we may be able to do something in this direction.

One general feature of all these vegetables is that they become ready for harvesting late, which means reduced income. Sullage irrigation is an important cause.

Summary of Brinjal* Account, 1938-1939

Field No. 12 — Area 1·34 Acres Irrigated.
Ref. No. L. 65, 103

Items of expense	Man-days.	Bullock-pair-days.	Equipment kind.	Equipment days.	Cost. Rs.	a.	p.
To manure share of veg. nursery expenses ...	...	...	...	...	8	8	0
„ sowing transplanting	3½	½	P.	½	1	11	6
„ irrigating ...	35	...	...	...	9	15	6
„ irrigation-water ...	...	...	...	...	40	0	0
„ weeding and roguing	9	...	...	...	2	6	0
„ cultivating ...	10	5	Cl.	5	11	3	0
„ harvesting and hauling ...	84	...	...	...	21	2	0
„ watching ...	8	...	...	...	2	10	0
„ hauling to market ...	26+	2+	C.	4+	12	4	6
„ marketing ...	...	...	...	...	31	11	6
„ supervision ...	..	...	...	...	22	11	0
„ cutting down dry brinjal stalks ...	3½	...	...	...	0	14	0
„ interest on Rs. 109 @ 5% for 3 mo. ...	...	...	...	...	1	6	0
„ use of land ...	...	...	...	...	28	0	0
Total ...	179	7½	..	9½	192	7	0
Per acre ...	133·6	5·6	...	7·1	143	11	6

*Eggplant (Solanum melongena).

Summary of Brinjal Account, 1938-1939.—(*Concluded*)

Receipts.		Yield.			Rate.	Value.		
		Number.	Mds.	Srs.		Rs.	a.	p.
By brinjal seedlings	...	...	...	...	...	1	4	3
" "	...	...	...	..	...	267	7	3
Total	...	...	...	...	...	268	11	6
Per acre	...	...	...	...	...	200	7	9
Balance, surplus	...	...	...	...	..	76	4	6
" per acre	..	...	...	...	..	56	12	3

NOTES

See the special note on Vegetables

In spite of the fact that brinjals also sell pretty cheap as others, it makes a decent income. It has paid better than potatoes. An old contractor of farm products in the past would compare brinjal crop to a cow. He meant to say that brinjal can be milked daily like a cow, when in milk.

Summary of Chillies* Account 1938-1939

Field No. 12

Area 0·66 Acres irrigated.

Ref. No. L. 66,104.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To share of veg. nursery exp. ...	...	...	...	...	5	0	0
,, seed Capsicum seeds 7 oz. ...	...	...	...	...	5	2	0
,, irrigating ...	10	...	...	...	2	14	0
,, irrigation-water ...	...	...	...	...	6	0	0
,, cultivating and weeding	6	1	Cl.	1	3	3	0
,, harvesting and hauling	45	...	...	...	10	15	6
,, watching ...	1	...	...	...	0	5	0
,, hauling to market ...	12+	...	...	...	3	12	0
,, marketing ...	...	...	...	...	7	4	3
,, supervision ...	...	...	...	...	9	5	0
,, interest on Rs. 44 @ 5% for 3 mo. ...	...	...	...	...	0	9	0
,, use of land ...	...	...	...	...	12	0	0
Total ...	74+	1	...	1	66	5	9
Per acre ...	112	1·5	...	1·5	100	9	0

*Capsicum frutescens (Solonaceae).

Summary of Chillies Account 1938-1939.—(*concld.*)

Receipts		Yield			Rate	Value
		Number	Mds.	Srs.		
						Rs. a. p.
By chillies seedlings	...	...	...	...	...	1 1 0
,, ,, ,,	...	...	...	...	...	67 10 9
,, okra	...	...	...	...	...	2 7 9
Total	...	...	...	...	...	71 3 6
Per Acre	...	...	...	...	...	108 0 0
Balance, surplus	...	...	...	...	...	4 13 9
,, per acre	...	...	...	...	...	7 7 0

NOTES

See the special note on Vegetable

Country chillies were grown. The Capsicums failed to grow.

Summary of Cabbage, Etc., Account, 1938-1939

Field No. 12, 13, 16, 19. Area 1·76 Acres irrigated

Ref. No. L. 75, 108.

Items of expense	Man-days	Bullock-pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To share of nursery expenses ...	...	...	...	...	19	0	0
„ manure and manuring	...	...	...	...	54	0	0
„ preparatory tillage Tractor discing ...	...	...	...	...	2	0	0
„ transplanting ...	3	1	P.	1	2	5	0
„ seed 45 Oz. ...	...	...	...	...	53	8	0
„ irrigating ...	19½	...	...	...	5	5	0
„ irrigation-water ...	...	...	...	...	26	0	0
„ cultivating and weeding ...	14	2	Cl.	2	6	6	0
„ harvesting and hauling ...	31	...	...	...	8	1	0
„ watching ...	12	...	...	...	3	10	0
„ hauling to market ...	½+	...	...	...	5	2	0
„ marketing ...	...	...	...	...	21	5	3
„ supervision ...	...	...	...	...	10	7	0
„ interest on Rs. 110 @ 5% for 2 mo. ...	...	...	...	...	0	14	9
„ use of land ...	...	...	...	...	13	0	0
Total ...	80+	3	...	3	231	0	0
Per acre ...	45·4	...	...	...	131	4	0

Summary of Cabbage, Etc., Account, 1938-1939 – (*concluded*)

Receipts	Yield			Rate	Value
	Number	Mds.	Srs.		Rs. a. p.
By seedlings ...	...	...	...	...	2 13 0
„ cabbages ...	...	...	...	...	123 5 9
„ cauliflower ...	...	...	...	...	28 0 6
„ knolkhol ...	...	...	...	...	28 11 0
„ beet, carrot, turnip, beans, sweet potato, radish, spinach ...	...	...	...	...	21 2 0
Total ...	...	...	...	...	204 0 3
Per acre ...	...	...	...	...	116 0 0
Balance, deficit ...	...	...	...	...	27 0 0
„ per acre ...	...	...	...	...	15 4 0

NOTES

See the special note on Vegetables

This sheet represents all the cole crops grown here and some others.

The details of the area are :—

Cabbage 1·12 acres, Cauliflower 0·42 acre, Khol rabi 0·14 acre, Carrots, Beet, Turnip, Radish, Bean, Sweet potato etc., were very minute fractions of an acre and many of them came from students vegetable plots.

The manuring cost of Rs. 54 is for F. No. 16 (0·84 acres).

The item of seed—45 oz. is the total of all seeds bought from seed-firms.

Cabbage has been much more paying than cauliflower and others included in the sheet. It seems that knolkhol here is rather more promising than cauliflower. Other minor vegetables are hardly worth much.

Summary of Tomato Account, 1938-1939

Field No. 19, 13. Area 1·77 Acre irrigated.

Ref. No. L. 69,105.

Items of expense	Man-days	Bullock-pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To share of veg. nursery expenses ...	...	...	...	...	15	7	0
,, preparatory tillage other Bullock operations ...	8½	6	P-R.	6	11	4	6
,, transplanting ...	4	½	P.	½	1	12	0
,, seed 2 ozs. ...	..	...	...	...	2	0	0
,, irrigating ...	10	...	...	...	3	0	0
,, irrigation-water ...	...	...	...	...	21	0	0
,, cultivating and weeding	10	2½	Cl.	2½	6	4	0
,, harvesting and watching	123	...	...	...	27	3	0
,, watching general ...	10	...	...	...	3	4	0
,, hauling to market ...	1+	¼+	C.	½+	3	8	0
,, marketing ...	...	...	...	...	11	9	9
,, supervision ...	...	...	...	...	21	11	0
,, interest on Rs. 87 at 5% for 2 mo. ...	...	...	...	...	0	11	9
,, use of land ...	...	...	...	...	25	0	0
Total ...	166½	9¼	...	9½	153	11	0
Per acre	94	5	..	56	86	7	0

Summary of Tomato Account, 1938-1939—(*concluded*)

Receipts	Yield			Rate.	Value		
	Number	Mds.	Srs.				
					Rs.	a.	p.
By tomato seedlings ...	...	...	...	...	2	5	6
„ tomato	...	...	...	...	117	11	6
Total ...	...	...	...	...	120	1	0
Per acre	...	...	...	...	67	12	9
Balance, deficit ...	...	...	...	...	33	10	0
„ per acre ...	...	...	...	...	18	10	3

NOTES

See the special note on Vegetables

This crop shows a loss this year but I do not think it is always a losing crop. The fault here with its cultivation is that it becomes ready late for the market when it goes quite cheap. Of course, the rainy season tomato crop does not pay. Crows do a good deal of damage in tomatoes. Watching is an expensive item.

Summary of Garden Peas Account, 1938 1939

Field No. 13,19. Area 0·43 Acre irrigated.

Ref No. L. 70,140.

Items of expense.	Man-days.	Bullock-pair-days.	Equipment kinds	Equipment days.	Cost. Rs.	a.	p.
To preparatory tillage: Bullock operations...	7½	7½	P. H	7½	13	6	0
„ irrigation-water ...	...	...	...	...	5	0	0
„ cultivating and earthing-up ...	1	½	...	½	1	0	0
„ threshing ...	1	1	...	...	1	8	0
„ watching ...	1	...	...	...	0	5	0
„ supervision ...	...	...	...	...	1	6	0
„ use of land ...	...	...	...	...	8	0	0
Total ...	10½+	9	...	8	30	9	0
Per acre ...	25·5	21	...	21	72	0	0

Receipts.	Yield. Number.	Yield. Mds	Yield. Srs.	Rate.	Value Rs.	a.	p.
By green peas ...	...	...	...	...	6	15	0
„ pea seeds ...	...	3	...	...	10	2	0
„ bean seeds ...	...	5	20	...	11	0	0
„ „ vines and straw	...	20	...	...	5	0	0
Total ...	...	...	...	...	33	1	0
Per acre ...	...	...	...	...	77	0	0
Balance, surplus ...	...	...	...	...	2	8	0

NOTES

See the special note on Vegetables.

The cost for the item of seed bed preparation may not have been for pea only.

It shows a surplus balance because of the inclusion of the income of beans which came from the students' plots, otherwise peas have resulted in a loss. There is something wrong with our pea crop. They fruit only lightly and late. The green pods do not fill in properly.

Summary of Onion Account, 1938-1939

Field No. 12, 13, 22. Area 0·48 Acre irrigated

Ref. No. L. 74, 105.

Items of expense	Man-days	Bullock-pair-days	Equipment		Cost		
			kind	days	Rs.	a.	p.
To share of nursery expenses ...	...	...	...	...	5	0	0
„ sowing	40	½	...	½	11	0	0
„ seed 2-seers ...	...	...	...	...	9	11	0
„ irrigating ...	20	...	...	---	5	12	0
„ irrigation-water ...	...	...	...	...	5	0	0
„ cultivating and weeding	20	...	...	...	5	8	0
„ harvesting and hauling	41	...	...	...	10	0	0
„ watching ...	5	...	...	...	1	9	0
„ hauling to market ...	4½	1	C.	2	2	12	0
„ marketing ...	...	...	...	...	2	9	6
„ supervision ...	...	...	...	...	17	13	0
„ interest on Rs. 68 at 5% for 3 mo. ...	...	...	...	..	0	14	0
„ use of land ...	...	...	...	...	12	0	0
Total ...	130½	1½	...	2½	89	8	6
Per acre	273	...	...	...	188	0	0

Summary of Onion Account, 1938-1939—(*concluded*)

Receipts	Yield			Rate	Value
	Number	Mds.	Srs.		
					Rs. a. p.
By weeds ...	...	...	...	...	1 6 0
„ onion seedlings ...	...	...	...	...	1 14 0
„ „	...	...	...	...	55 4 9
Total ...	...	...	...	...	58 8 9
Per acre ...	...	...	...	...	123 0 0
Balance, deficit ...	...	...	...	...	31 0 0
„ per acre ...	...	...	...	...	64 12 0

NOTES

See the special note on Vegetables.

Onions have resulted in a loss as expected. The most outstanding feature of this crop is that it is perhaps the highest in labour requirement. As such, with paid labour it certainly becomes very expensive.

It seems that it does not thrive on sullage irrigation. This combined with summer heat makes it lose considerably by rotting both in the field and store or market.

Summary of Banda* Account, 1938-1939.

Field No. 13,16. Area 4·6 acres irrigated.

Ref. No. L. 77,109.

Items of expense	Man-days	Bullock-pair days	Equipment kind	Equipment days	Cost Rs.	a.	p.
To preparatory tillage: Bullock operations ...	16	15½	P	15½	27	1	6
,, Sowing ...	140	½	Cl.	½	38	11	0
,, seed Banda 97 mds. 10 seers plus hauling	4	½	C.	1	147	0	0
,, irrigating ...	151	...	...	...	46	11	0
,, irrigation-water ...	...	...	...	...	40	0	0
,, weeding ...	7	...	...	...	1	10	0
,, cultivating and earthing-up ...	11	5½	Cl.	5½	11	11	0
,, harvesting and hauling	71	...	...	...	17	0	3
,, watching ...	56	...	...	...	16	4	0
,, hauling to market ...	13	½	...	6	4	14	3
,, marketing ...	...	...	...	..	11	3	0
,, supervision ...	...	...	...	...	51	0	0
,, interest on Rs. 345 @ 5% for 6 mo. ...	...	...	...	...	8	10	0
,, use of land ...	...	...	...	...	70	0	0
Total ...	469	22½	...	28½	491	12	0
Per acre ...	102	5	...	6·2	106	12	0

* Colocasia sp.

Summary of Banda Account, 1938-1939.—(*concluded*)

Receipts	Yield			Rate	Value
	Number	Mds.	Srs.		
		Standard			Rs. a. p.
By weeds ...	...	...	...	.	1 5 3
,, Banda 83 mds. 30 seers Pucca ...	...	133	...	...	102 6 6
,, Banda stored and rotten ...	...	32	...	...	...
Total ...	...	165	...	...	103 11 9
Per acre	...	36	..	...	22 9 0
Balance, deficit ...	...	...	...	...	388 0 3
,, per acre ...	...	...	...	...	84 3 0

NOTES

Banda is 10 months' crop. Many times we have lost in this crop rather than gained. It grows throughout the summer when in spite of copious irrigation, it often suffers.

This year this crop was planted considerably late, most of it being on the field No. 13 used for Farmers' Fair ploughing contest. It needed re-sowing. The plot was so patchy that the scattered plants were brought closer together by transplanting so that part of the area thus set free was ploughed up and planted to maize crop. While Field No. 13 practically failed, Field No. 16 (1·5 Acre) yielded about 100 maunds (standard) which works out to a about 66 maunds only per acre.

About 32 maunds of Banda were reserved for sowing next crop. Eventually it was decided to stop growing Banda.

If you would civilize a man, begin with his grandmother."—*Victor Hugo.*

A Book Review

Marketing of Sugarcane and its Products BY RAM DAS; *Published by the Economics Club, D.A.V. College, Cawnpore, November, 1941. Price Re. 1·8 net.*

This booklet gives in a brief and compact space a lot of useful information regarding the sugar industry in the United Provinces. Sugarcane holds an important place among agricultural produce in these Provinces, for it claims nearly 50 per cent of the area of sugarcane in India; and, it has been producing nearly eleven crores worth of *gur*—a product more important than refined sugar as far as these Provinces are concerned. Starting with the harvest, each step in the marketing of sugarcane and its products is carefully dealt with. This includes assembling, grading, storage, transportation, and wholesale distribution. The demand and the supply sides of the problem are also considered with statistical data for the last ten years; and, the effect of these on the price forms the subject matter of one full chapter. No treatise dealing with sugarcane in the United Provinces can afford to neglect the problems that this crop introduces which call for State action. The author has, therefore, wisely introduced a chapter on the legislative actions taken with respect to this industry.

Since this study was originally undertaken as a Master's thesis, one wonders why statistical methods—the modern indispensable tool of the research scholar—were not used in the analysis of the figures. For example, the monthly price of *gur* is given for five years to show "the trend of prices from month to month". The variation due to the fluctuating general price-level and the long time trend could have been eliminated statistically and the index of prices due to seasonal variation alone could have been easily determined. A graph would have brought the result within the limits of understanding of the layman It must be remembered, however, that such charts are rather expensive to print; and therefore they might have been omitted purposely.

These small defects should not distract us from the very valuable service that Mr. Ram Das has done to those interested in the improvement of sugarcane in these Provinces. Had he merely given us facts and figures, we would have been unhappy; but he has ably interpreted what these figures mean in a simple language that anyone can understand. This booklet will be of great use not only to students in all agricultural colleges, but also to the government officers, teachers, and all those who want to know something about the sugar industry in these Provinces. It is certainly worth more than what it costs. The Economics Club of the D. A V. College, Cawnpore, must be congratulated for getting this valuable work in print.

HENRY S. AZARIAH.

"Life is what we are alive to. It is not a length, but breadth. To be alive only to appetite, pleasure, pride, money making and not to goodness and kindness, purity and love, history, poetry and music, flowers, the arts, God and the eternal hopes, is to be all but dead."

—*Maltbie D. Babcock.*

"Why are you crying, little girl?"
"'Cause my brother has holidays and I don't."
"Well, why don't you have holidays?"
"'Cause I don't go to school yet."

If one cannot improve himself, or serve men, how can he improve others, or serve God?"—*Confucius.*

The aim of education is merely the development of good taste in knowledge and good form in conduct. The cultured man or the ideal educated man is not necessarily one who is well read or learned but one who likes or dislikes the right things."—*Lin Yutang*.

REPORT FROM THE UNITED PROVINCES DEPARTMENT OF AGRICULTURE

JANUARY, 1942

I—Season.—During the month of January, 1942, rainfall was general though the first week was rainless. Except in the districts of Aligarh, Muttra, Mainpuri and Etawah the rainfall was above the normal and was definitely beneficial to the standing crops.

II—Agricultural operations.—Agricultural operations are up to date. The crushing of sugarcane, preparation of land for sugarcane and extra crops and the irrigation of rabi crops are in full swing.

III—Standing crops and IV—Prospects of the harvest.—The condition of the standing crops and the prospects are on the whole fairly satisfactory. The recent rain has improved the condition of the crops especially in dry areas.

V—Damage to crops—Slight damage to crops from hail storms is reported from the Muttra, Pilibhit, Farrukhabad, Allahabad, Basti, Azamgarh, Lucknow, Unao, Rae Bareli, Sitapur, Kheri, Fyzabad, Gonda, Partabgarh and Bara Banki Districts Some damage is also reported due to frost from the Agra, Budaun, Kheri and Bara Banki Districts. In a small part of the Partabgarh District, damage from hail is reported to be considerable.

VI—Agricultural stock.—The condition of agricultural stock is on the whole, fairly satisfactory though cattle disease is reported from several villages of certain districts. The following figures furnished by the Director of Veterinary Services, indicate an improvement over the previous month's figures. Haemorrhagic septicamia, however, has increased to some extent.

Disease	December, 1941		January, 1942	
	Affected	Deaths	Affected	Deahs
Rinderpest	931	528	832	521
Foot and mouth .. .	1,603	16	832	2
Haemorrhagic Septicamia	114	100	195	145

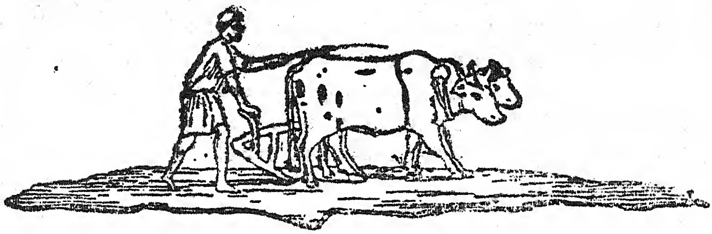
VII—Pasturage and fodder.—Pasturage and fodder are reported to be sufficient everywhere, except in the Meerut, Aligarh, Muttra, Agra and Etah Districts, where some scarcity is reported.

VIII—Trade and prices.—As regards the prices of the chief food grains, those of barley and gram have risen slightly, while wheat, rice and arhar dal show a decline. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month :

	End of December, 1941	End of January, 1942
Wheat	5·461	5·341
Barley	3·563	3·602
Gram	4·022	4·161
Rice	6·975	6·881
Arhar dal	5·319	5·241

IX—Health and labour in rural areas.—The condition of agricultural labour is fairly satisfactory. Stray cases of plague, small-pox and influenza are reported from certain districts.

THE ALLAHABAD FARMER



VOL. XVI] JULY, 1942 [No. 4

Editorials

Cattle Shows and Cattle Improvement.

Cattle Shows have become a regular activity of the agricultural departments of this country. These shows have proved to be of very great value to the cattle industry in this country in that they have created a great deal of interest in the improvement, not only of cattle, but of all kinds of domestic animals. The All-India Cattle Show held every year in Delhi has already made possible the bringing together at one place all the important cattle breeds of India. In this way it has made many an animal breeder in this country realize, perhaps for the first time, the great potential wealth that India has in the breeds of cattle in this country. Cattle shows have also stimulated the interest of the cattle raisers in good and judicious feeding. These shows, we have no doubt, will continue to make their contribution to the development of sound economic animal husbandry.

But much as we appreciate the great value of these shows, we feel that we cannot but draw attention to some

of the adverse influences of such shows on the economic improvement of cattle in general. For, while we believe that certain economic points of an animal can be judged in a fair or a cattle show, there are important economic characters which cannot be determined by looking at the animal. Also when a bull is judged for the milk capacity of its female progeny the matter becomes doubly difficult. The "milk markings" of a bull are, as far as we know, fictitious. Also we know of no way of determining the fat percentage of the milk of a cow simply by looking at the animal. We believe that for the very important characteristic of a cow of a certain breed, namely economic milk yield, judging in a show ring is almost an impossibility

Standards set up for a show ring may therefore simply result in standardization of a breed of animals with no guarantee that the breed would show improvement in milk yield, or in the total amount of butter fat.

To make our point clear we draw the attention of our readers to the fact that Leghorns, a breed of poultry with a very high egg-laying capacity, always possess yellow legs. It was therefore believed by some that the more yellow the legs, the more eggs a hen would lay. Investigations, however, have proved this to be untrue.

In the same way we do not believe that any judge in a show ring would rate a spotted Sindhi bull very high, although we believe the spotted character has no relation to the capacity for milk yield of the Sindhi breed. It has always been the general idea in animal husbandry that a type represents an ideal or standard of perfection That is, the common belief is that this ideal type combines all the characters which contribute to the animal's value and efficiency. "This," says L. M. Winters *, professor of animal genetics of the University of Minnesota (U.S.A.), when writing on this subject, "is a pretty idea, but unfortunately it is frequently far removed from the facts."

This however does not mean that we do not believe in the existence of a dairy type as different from that of a non-

* Winters, L. M: Animal Breeding, pp. 150 ff

dairy type, or that we do not believe in the capacity of well trained dairy men to judge dairy cattle. But we do believe that there is a danger in putting too great an emphasis on the show points which may lead to the rejection of really good economic cattle or to the putting of too great a value on certain animals which do not really have a great economic value. Dr. Hagedoorn*, a distinguished Dutch geneticist and animal breeder, who has had considerable experience with the breeding of animals in oriental as well as occidental countries, says: "Whenever anybody has taken the trouble, however, to study the correlation between show points and economic value, this correlation has always been shown to be insignificant." In fact, he went on to say, "In the production of economically-usefull animals, however, such as cattle, swine, egg-laying breeds of poultry, and horses, the show ring is more of a menace than an aid to breeding." These are very strong words. But we quote them here as we do not wish our country to fall in to the mistakes of doing something which is not the best for the country.

As we write, two pictures which appear on pages 311 and 312 of Snyder's book on "The Principles of Heredity" come to our mind. One picture is of a bull accepted as a very superior sire by accepted show-ring standards, but which has consistently lowered the average milk production of his daughters below that of their dams. Another picture is that of a bull accepted as a very inferior sire by show-ring standards, but which consistently raised the milk production of his daughters far above that of their dams. The author says that only progeny tests could show the true transmitting value of the bulls referred to. With insemination now used as a tool in animal breeding, one cannot be too careful in selecting the right kind of a sire.

And for a country like India, it seems to us that the most important criterion with any domestic animal is not so much the appearance of an animal or even the 'pail tests' in the case of cows, or the number or quantity of eggs in the case of hens, but whether the animal is the best economic producer ; or whether it is the one best adapted to the condi-

* Hagedoorn, A. L: Animal Breeding, pp. 232 ff.

tions of agriculture in which it is found. Similarly, we do not believe that any plant breeder in this country would judge the yielding ability of maize by the appearance of an ear of maize as demonstrated in a flower or an horticultural show.

In spite of these limitations we believe that shows and fairs, in this country have contributed something to cattle improvement and that this contribution can be maintained if those who set the standards and do the judging constantly also use standards which are related to economic production, and eliminate points which have no relation to efficiency. In a business way fairs and shows are also important media of advertising, and they offer opportunities for exchanging news and ideas with other breeders.

The New Agricultural Engineering Course.

This year, for the first time in this country, an Agricultural Engineering course of a University standard has been instituted by the Allahabad University. The course will be taught at the Allahabad Agricultural Institute. This has been made possible, we understand, by the grant to the institution from the United Provinces Department of Agriculture. We congratulate the Director of Agriculture and the authorities of the Institute on this bold move made by them

We also take this opportunity to thank authorities of the Allahabad University for the interest shown by them in the scheme. It was mainly due to their interest that this scheme has so soon come into being.

We hope that the course will take India one step further to the rapid mechanization of agriculture and thereby raise the standard of living of our Indian farmer.

ERRATA

In the article on "Pyrethrum—Its Utility and Possibilities" which appeared in the March, 1942, issue of the Allahabad Farmer, substitute the word "pyrethrin" for "pyrethrum" in the 1st, 4th and 5th lines of the 4th paragraph under the heading "Cultivation of Pyrethrum in India," and in the 2nd line of the 5th paragraph under the same heading. B.M.P.

SUGGESTIONS FOR THE FUTURE DEVELOPMENT OF AGRICULTURAL ENGINEERING IN INDIA

BY

MASON VAUGH

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For this article I have taken the liberty of discussing not so much the development of agricultural engineering as a separate science but rather the development of Indian agriculture by the utilisation of engineering knowledge. I have of course assumed that this application of engineering knowledge to agriculture can be best done by those trained in both engineering and agriculture, that is by agricultural engineers.

The first suggestion I would make for the future development of agricultural engineering in India is the urgent necessity of training agricultural engineers in India for Indian conditions. The need for agricultural engineering services has been more or less dimly felt in the past. The attempt has been made to meet the need by the appointment of "—engineers with experience in agricultural engineering" or by the transfer of men from other engineering departments or services. Advertisements in India and even in England for men with agricultural engineering training have failed to secure men. Apparently in England an agricultural engineer is either a dealer in agricultural implements or an engineer who has had a training in mechanical engineering in a factory manufacturing agricultural implements. I have found no trace of any educational institution in the British Isles giving professional training in this subject. No college of either engineering or of agriculture in India at present gives such training though arrangements are under way for the initiation of such a course by the Allahabad University, to be taught at the Allahabad Agricultural Institute.

In other lines of work we employ specialists trained for their job. It would be no more absurd to employ a chemist to do research in plant breeding than it is to employ a civil engineer trained to design and construct canals, roads, and buildings, or a mechanical engineer trained in the operation of big power plant or in manufacturing methods to conduct research on improved implements or their application to agricultural practices. Doubtless sound scientific training in any subject is a help in mastering any other and it is also true that a soundly trained science graduate, given sufficient time, should be able to master after a fashion an unfamiliar branch of science but the practice of employing specially trained men is too common to need more emphasis here. We have both agricultural colleges and engineering colleges of high standing and ability in India. Sending men abroad for this training may be good in some instances but is hardly a means of supplying the number of men needed. At present there are perhaps some 7 or 8 men in all India with professional training in agricultural engineering and one of them is a preacher.

A sound professional training in agricultural engineering should include three phases. First, it should include a sound basic training in agricultural principles, particularly the knowledge of chemistry, botany, soils and animal husbandry, necessary to understand the fundamentals of plant growth. This training should be both theoretical and practical, that is in addition to class room and laboratory training the student should have some actual experience with things growing in soil. This is fairly well covered by the present Intermediate agriculture syllabus of the United Provinces. In addition to this, the agricultural engineer should have definite training in farm management and rather more agronomy would be an advantage.

Secondly, it should include a sound training in engineering fundamentals and processes. It should cover such subjects as manufacturing methods, particularly those applying to the manufacture of implements along modern lines, engineering drawing and structural design including special attention to design of agricultural buildings, a sound training in mechanics and statics, elementary training in electricity

and its application particularly to motors and to distribution systems for rural electrification, and the application of engineering principles to the construction and operation of agricultural implements and machinery as engineering devices.

Thirdly, the training of agricultural engineers should include some intensive training in the application of engineering principles to agricultural problems. The practical application of engineering principles should be kept in mind at every stage. While the engineering training should be sound engineering, it should not be taught abstractly but as an applied science.

Having provided for the training of agricultural engineers, it may be necessary to do some education of agricultural department officials and possibly others to see the extent to which the problem of improving Indian agriculture, or rural development, is a problem of applying engineering to the agriculture of India. The supply of water has been recognised as an engineering problem. Vaguely, the development of better implements has been recognised as having engineering implications. So far, in India, the processing, preparing and storing of farm produce has not been studied as an engineering problem and apparently no one recognises that there is a problem of improving the *housing* of the villages, their cattle and crops. The tremendous problem of soil and water conservation, particularly the control of erosion, but also certain phases of manuring and water storage are beginning to be recognised, but I have seen no sign that they are considered engineering problems as they are in western countries, particularly the Americas. For the most part, it appears that rural development or the improvement of Indian agriculture is considered to be a matter of crop improvement, (with the use of manures and better implements as subsidiary to crop improvement,) cattle improvement and the control of diseases and pests of both crops and animals. I shall try to point out certain fallacies in this idea at another place in this article.

Before discussing in detail lines for future development of agricultural engineering, it seems desirable to clear up certain things which in my opinion have been misunderstood and

being misunderstood or *not* understood, have hampered progress in agricultural engineering and in agriculture generally.

In our certainty that we are experts, we are sure that any failure to accept our opinion as final can only be due to a defect somewhere in others. A convenient excuse for improved implements not catching on has been the poverty of the people. The cultivator has found that it is the easiest defence mechanism with which to get out of accepting something which for other reasons he does not want. The public accepts it and we, without a real investigation , are also misled by it. There is no doubt whatever that the standard of living of the cultivator is low. Equally without doubt, many of them are very poor and very few of them can afford to experiment. Still, it is not possible to provide at once improved ploughs, for instance, for the replacement of the 5,000,000 ploughs now in use in the United Provinces. It is always the more progressive—and they are usually the more prosperous—who first adopt any improvement or innovation. The same man who "cannot" find Rs. 5 to Rs. 10 for an improved plough will find 5 to 10 times that or even more for a wedding. Many of them do find Rs. 20 to Rs. 40 for the *hire* of a sugar cane crusher for a single season I am convinced that in spite of the fact of the very real poverty of the Indian cultivator, suitability of implements or rather the unsuitability of what has been offered has been a far more effective deterrent than has been the poverty of the cultivator.

Much the same applies to the charge of excessive conservatism. I feel that we have been unfair and unjust in our charge of excessive conservatism. Again I say, the cultivator cannot afford to experiment. He rightly needs to be sure that a new implement or tool will function well under his conditions before he ventures. When he is sure, he adopts new things with alacrity. The completeness with which the iron roller sugar cane crusher has displaced the old crushers in only two or three decades is evidence of this. The extent to which the engine driven flour mills have spread over the country is another. The use of hurricane lanterns, bicycles, matches, the sewing machine, has become common where improved ploughs are still practically

unknown. It would be strange if conservatism were a selective force, applying to agricultural implements only. It does not seem to deter people from using the motor lorry or bus or the train. It may be easier on our pride to charge the cultivator with conservatism than for us to admit that perhaps our recommendations are not perfect, but is it just or is it conducive to getting on with the job of improving Indian agriculture ?

Some Real Difficulties the Cultivator Faces.

There are certain real factors in the situation of the cultivator which are very great difficulties in his way. While he may not be excessively conservative as an individual, it is true that religion and social custom are against change. Indian religions are fatalistic; the Hindu cultivator believes he is what he is because that is what in past lives he has deserved to be; the Muslim cultivater believes that he is what he is because his fate is that—in neither case is there much to be done about it. Indian social life in general is built around group control and does not encourage innovation. The individual is not free to do as he pleases in many phases of his life. At least in North India, the zamindari system has often been a brake on progress, the zamindar tending to take in one way or another any benefit accruing from any innovation in crop or practice and quite generally discouraging innovations.

The mistake of failing to understand and utilise the "jajmani haq" system under which indigenous implements and tools are made and repaired, has been a deterrent to the introduction of better plouhs in many cases. Through most of North India at least, there is a customary arrangement by which the cultivator pays the village blacksmith an annual fee—which may be paid in semi-annual instalments—in return for which the blacksmith maintains in working order a specified set of implements, making new ones from material furnished when necessary. The cultivator has no tools of any sort and no experience in using them. He is completely dependent on the blacksmith for the simplest repair or adjustment of the implements used. We come to the village

and demonstrate a better plough The cultivator is impressed and asks about repairs. We, conscious of the rapid wear on wooden tools, assure him that the only repair ever needed is occasional changing of the shares and that he can get new ones at that seed store. It is self sharpening and won't break. The blacksmith overhears this. The cultivator from his experience is not so sure so he consults his blacksmith as to whether he can repair the plough or not. If the cultivator is influential, the blacksmith may not dare say that he *will not* for there may be ways of putting pressure on him. If what the demonstrator says is true, he sees an end to his livelihood from the general introduction of such ploughs. The safe thing is to say that he *cannot*, which he says. The cultivator knows that, watever the demonstrator says, sooner or later he will need the blacksmith's help so he plays safe and leaves the plough alone.

Probably our greatest mistake has been our failure to treat the cultivator's implement problems comprehensively. We come along and see the, to us, obvious shortcomings of the *deshi* plough. Western agriculture is the finest in the world; western agriculture uses soil inverting ploughs; therefore—and we proceed to introduce soil inverting ploughs without considering that the deshi plough is a sort of universal implement used for a variety of purposes for which the soil inverting plough cannot be used. We find that what seems to us a small plough seems too heavy a load for the cultivator's oxen, so we proceed to reduce the size without any real study of the other factors which may affect the draft of the plough or the ability of the bullocks to pull it, getting finally as a result something which resembles a soil inverting plough in appearance but which is so small and has such structural defects as to make it of very little use for the purpose for which we want it. We find that it does only part of what the *deshi* plough does a little better perhaps, but not nearly well enough—and when the cultivator is not enthusiastic about the result we decide that the reason is because he is excessively conservative ! At no stage have we considered as one whole, the work he does through the year or the work he needs to do. We have only succeeded partially in providing a substitute which we end up

by recommending that we use a couple of times in the rains, advising him to revert to the *deshi* plough for other work. The plough we have given him is still not of any real use for the real job for which a soil inverting plough is needed, that of green manuring, because it is too small.

The Technique for Future Development of Implements

My first suggestion for the future is that a thorough study be made of the social custom, village organisation and economic factors which may effect the introduction of implements. The study may need to be made independently in different sections of India as factors will vary in importance from place to place. Such studies should be made certainly by people who have training in agriculture and preferably some knowledge of agricultural engineering. A bit of training in elementary psychology would be invaluable, and patience and insight into the ways of the people will be essential. While some books may give useful information, the study will have to be made of people and their ideas directly, if it is to be of value. It will be essential to get the confidence of the people, to really get at their ideas and a half hour's visit to a strange village is likely to be useless. The study should be approached with a desire to *learn* the facts, not the intention to prove a theory already formed.

The second suggestion is that agricultural engineering research be on a more comprehensive scale than hitherto. We should not set out to develop a small soil inverting plough but rather to study the problem of seed bed preparation throughout the year. This should be co-ordinated with such practices as green manuring, dry weather ploughing, and any other special practice recommended for the section. Such studies should aim at developing, in conjunction with other agricultural workers, a co-ordinated system of agricultural practice into which the implements would fit to give the maximum economy of labour with the maximum of return in crop yield. It is not proposed that the agricultural engineer should pose as an expert on all phases of agriculture but rather that he carry out his work to fit into the work of the soils and crops workers with whom he should be associated.

Neither he nor they should work alone or with a desire to do something patentable or for which he alone could claim credit. Other problems should be tackled in much the same way. While a reasonable choice of tools and implements is a good thing, excessive multiplication of implements should be avoided. We should not try to develop a new type simply to avoid using something developed by another worker or in another province Tests of a new type or design should be conducted open-mindedly and should include comparison with existing types. Too often we get a brain wave that some new device would work better than the existing one and an effort is made to perfect the new device with no real study of basic principles or any attempt to determine whether some other principle of operation may not give far better results. Too often we tinker with improvement of a design rather than consider the fundamental principles, often because the worker is not sufficiently trained to know, or to deal with, fundamental principles.

My third suggestion is somewhat related to the above. We should give more attention to long range objectives in planning our research programme for implements. Of course we say that our objective in all our agricultural improvement work is to raise the standard of living of the cultivator. So far, so good, but that is very general and not very definite. Some much more definite and immediate objective would be conducive to more definite results. Just as we should not too closely restrict our objective, we should not be too diffuse Possibly in recent years we have been frightened by the spectre of unemployment and have been unwilling to face the real objective of the introduction of better implements, *the better utilisation of human labour*. The widely used term "labour saving" is not entirely satisfactory for it does not express the idea of better utilisation but seem to restrict the objective to a reduction in amount of labour. While I still think that a worthy objective, it is not the whole and it is momentarily in disfavour with many. Perhaps a restatement of our objective may serve both to give us a clearer idea of what we are attempting and of more clearly stating our position to the public. The following is an attempt at such a brief statement.

Man is a tool-using creature. He began the process when he first used a stone to crack a nut, or a stick to kill a bird, or an animal for food. From that time, man's history of progress, his conquest of nature, his improvement in material standard of living, has been measured and controlled by his progress in the use of tools. The simpler the tools, the greater the amount of hand labour required for the production of a given quantity and the lower the standard of living measured in terms of consumable goods and services. High production per acre can be secured with simple tools, high production per worker cannot. The production per worker, whether secured by increasing the acres cultivated or by increasing the production per acre or by a combination of both, is a function of the tools used. We can consume what we produce. If we produce more, we can consume more; therefore if we use better tools, we can have more to consume in proportion to our use of better tools.

Within limits, even unemployment is not intrinsically a bad thing. When we call it leisure, each of us strives for at least a reasonable amount of it and most of us would like to be able to have as much of it as we wish. Most of us like to work some, if we can choose how much and what we shall do. Even for the "lower classes" I doubt whether modern opinion will maintain that unrestricted labour is necessary to happiness or to keep the people out of mischief. Surely we can devise other alternatives. Excessive leisure that leaves some still struggling almost day and night while others have no means of livelihood is bad. However, the distribution of both work and produce is a matter of social organisation and surely if our intelligence is enough to enable us to device means of increasing production, it should be enough to enable us to devise a social organisation for the distribution of both the labour of producing and the goods produced. I conclude therefore that unemployment is not a reason for hesitating to improve implements lest we cause unemployment.

In fact the first generalised objective I would suggest would be the working out of such a combination of improved implements and cultural practices as would reduce the need

for the large amount of casual seasonal farm labour now required, particularly the necessity of employing large numbers of women and children in field work. A large part of the work done by women and children is weeding and interculture. As performed with a *kurpi*, this is an incredibly inefficient use of human labour. Trials at Allahabad indicate that it is possible to entirely or nearly entirely eliminate this hand weeding by sowing in lines and interculture with bullock drawn implements, without a reduction – in fact with an increase—in yield. This involves for each crop the working out of the best combination of seed rate, spacing in row and between rows, the abandonment of the sowing of mixed crops or in use of some combination by which the mixture is by alternating rows of different crops or by admixture within the row or by seeding the admixed crop after the row crop has been intercultured and possibly other agronomic factors. It will also involve the development of interculture implements suited to the soil, the cropping system and the power available—and with attention to the purchasing power of the cultivator and the intelligence of the workman who will handle the tools. It should be carried out as a cooperative project of both agricultural engineers and agronomists and will have to be done for different crops and for different crop areas. Such a study would not solve all the problems of releasing women and children from field work but would be a foundation study toward it. Bringing into effect of the results of such a study would also facilitate advances in harvesting methods of the crops involved which would further release women and children.

I would urge concentration on such improvements first being effected as would release women and children because little can be done to improve the homes of the poorer classes until the wife and mother is able to give her time to it, instead of to earning by work outside the home. Similarly, many families of agricultural labourers cannot afford to lose the earnings of the children involved in sending them to school. This means that along with technical improvement releasing the labour of women and children must come a corresponding increase in the wages of the labourer man who is able to accomplish by the improved implements and

practices the same work formerly done by man, woman and children. This will be automatic in case of those cultivators who actually do their own work and whose women and children work with them. The result will not be nearly so automatic in the case of the large class of cultivators who have farm work done by hired ploughmen and by hired coolies. Increasing industrial demand for labour will partially or possibly wholly care for this. Other means may have to be used in case the industrial employment should lag behind the release of labour from agriculture.

It may be objected that what I have said up to now about further progress is mostly in the nature of philosophy of agricultural engineering. I would justify this treatment of the subject by the fact that in my opinion research in the past on agricultural engineering subjects has been desultory, often inconclusive and so comparatively ineffective, just because the objectives soughtw ere similarly vague and not clearly defined or understood. When we have trained workers and a basic understanding of what we want to accomplish clearly defined into units capable of being tackled logically, we can hope for rapid progress in improving implements suited to Indian agriculture.

Technical Suggestions

I now propose to make certain observations on more technical details. First, I would point out that research should be directed toward developing implements which can be utilised on areas approximating those now available to the larger cultivators in each area. Some margin of capacity may be desirable but in general the implements should not require abnormally large areas for their success.

Secondly, the power for working the implement is equally as important as the implement. Special attention should in all cases be given to reducing the power required by attention to design and construction factors which may influence power required. A slight increase in cost accompanied with a distinct gain in efficiency may be well worth while. The question of improving the bullocks hardly comes into the scope of this paper. I would, however, in general, design for

use by the better 50% of the animals commonly in use in a region, not for the smallest nor for animals larger than those commonly used. Due attention should be given to improvement in yoking. As much as 25% increase in work done may be secured in some cases by simply changing the yokes for a better type. Some few operations may justify the use of two pairs of oxen working together but where possible, implements should be capable of operation with one pair. Care should be taken, especially on Government and demonstration farms generally, not to work implements with animals bigger than necessary. The use of big heavy Punjab bullocks with Meston type ploughs on Government farms has spread the impression that such bullocks are necessary and where it is realised that smaller bullocks are strong enough, it has lowered the prestige of the farm in the eye of the cultivator. (The Agricultural Institute, Allahabad, has a scheme before the I.C.A.R. for a thorough study of yokes and harness and for a preliminary study of the correlation between body conformation and draft ability).

Certain problems needing investigation have been mentioned as illustrating principles or statements made. The following is a suggestive list of investigations which in my opinion need to be carried out, keeping in mind the principles laid down above. It is not meant that this list is exhaustive or complete but only suggestive.

1. The relation of improved implements to soil fertility, particularly in relation to dry weather ploughing and to green manuring. I believe that a properly worked out and applied cropping system including regular green manuring will in a few years double the average yield per acre of most areas in India but this can only be accomplished if improved ploughs come into general use.

2. A full investigation of the problem of fodder production and storage under village conditions, including particularly the possibility of making silage. It should not be simply assumed that nothing can be done. Investigations should be carried out to determine the minimum practicable size of silo, the minimum herd for which a silo is practicable, the conditions to be met to make such a silo

practicable, how nearly the average cultivator of each typical area comes to having the required conditions and possibly whether any do. There is at present a shortage of fodder. This can be met partly or wholly by a reduction in the number of cattle, by use of more efficient implements, by increased production in some cases and by better preservation and utilisation.

3. The problem of harvesting, both of *kharif* and of *rabi* crops. Possibly next to weeding and interculture, the harvest is the operation which makes the biggest demand for seasonal labour. It was improvement in the methods and equipment for harvesting which really initiated the agricultural revolution in western countries. While it is not always realised, present methods of hand harvesting are not only wasteful of human labour but often result in substantial loss of grain by shattering.

4. Improved methods of threshing, winnowing and grain dressing should give a substantial increase in the income of the cultivator. It is commonly said that 10 per cent. of the grain grown never gets into the store. A substantial part of the loss occurs on the threshing floor where insects, birds, rain, rodents, fire, all take their toll. Any development that will reduce the time that grain lies on the threshing floor will reduce this potential loss. This is also tied up with the problem of dry weather ploughing to some extent. Any development which reduces the time oxen must spend on threshing will increase the time available for other operations.

5. There is real need for a device for lifting water efficiently for small lifts. Many canals run just below the surface so the water has to be lifted for use. Many small and medium sized streams occur where it is not practicable to make canals but where the water could be used with a lift of five feet or less. In some cases jhils, swamps, etc., provide a considerable supply of water. No device so far has come into general use to compete with the few deshi devices. It appears likely that a study of the fundamental hydraulic and mechanical principles should yield a bullock operated device for these conditions which would do for the

farmer what the Persian wheel has done for those having larger lifts.

6. The present Persian wheel is a great improvement on the old wooden one with grass ropes and clay pots. For shallow depths, it works fairly well but in deeper wells wear on the chain is very severe. There is need for a better chain for carrying the buckets and possibly for better bearings. There is need for the investigation of the possibility of better gearing, arranged for separation from the chain wheel so that it can be used for other purposes.

7. Very little attention has so far been paid to the possibility of using bullock power for some of the power needs requiring rotary power, other than the Persian wheel. While it is true that generally a pair of bullocks cannot be expected to develop more than about one horsepower, that amount of power can be usefully applied to a number of jobs provided it is used by efficient machines. If the bullock gearing is separate and easily attached, the cost may be kept within the reach of the better-off cultivators and contribute materially to their welfare.

8. A rich field for investigation lies in the whole subject of soil and water conservation Agriculturists generally seem to assume that only level land is culturable. A great deal of labour and trouble is expended in levelling all fields into bench terraces, whether they are to be irrigated or not. Fields are quite generally bunded to impound the rainfall and no provision is made for drainage or runoff. The bunded fields are rarely able to hold the heavier rainfalls so breaks occur and these are caused often with moderate falls by rat and other rodent burrows in the banks. The impounded water often causes severe erosion when breaks occur. Gullies once started are with present practices generally uncontrollable. Not only in the hills and on high river banks but all over the plains enormous losses of top soil occur. The soil being hard and compact when the first rains fall at the beginning of the rainy season, the first rain often carries off any manure, crop residue or other organic matter remaining on the fields. Some of this loss can be controlled by engineering structures such as soil saving

dams, *pakka* or grassed spillways, terraces. Either in combination with these means or alone much can be done with cultural practices with suitable implements. Examples are loosening the soil by dry weather ploughing and possibly basin listing. Much can be done by the use of cover crops on all fields not carrying kharif crops and by early planting of kharif crops so the fields are covered early in the season by the crop. The possibility of using a low growing leafy legume interplanted in fodder crops after one or two inter-cultures to serve as a cover crop needs to be investigated. Again this investigation needs to be carried on jointly by agricultural engineers and crops men.

9. Transportation of crops from field to farmstead and from farm to market in head loads is one of the very large wastes of agricultural labour. The amount of useful work which a man or woman can do this way in a day is very small. There is need for development of suitable carts for the handling of farm produce both on the farm and for transport to market This will involve consideration of farm roads and of village roads. What should be the load capacity of the cart in terms of weight and in terms of volume ? What materials are most economical ? What is the best design of cart as a whole and of individual parts, as wheels ?

10. What is the need and what is the possibility of farm fencing in India ? Is it necessary or desirable to fence individual plots or is it possible to fence village areas ? What changes would be needed in present systems of cropping or of land tenure before fencing can be satisfactorily adopted as a general practice ? What materials will give the best combination of desirable characteristics, economical first cost and low maintenance ?

11. While any extensive rebuilding may have to wait for some rise in the standard of income, it is not too early to begin survey studies of the building needs of the cultivators. What is the extent and cost of cultivators' residences, what improvements are needed, which ones can be made at costs within the means of the cultivators, what are the improvements of which the people now feel a need, what

improvements can be easily introduced with propaganda and demonstration, how many cattle are kept and what provision if any is made for housing them, what provision is needed for storage of fodder and feed, can such storage be combined satisfactorily with storage for other grain and seeds, are some of the questions which should be investigated and the answers put on record for the different areas. With much information on record, experimentation and propaganda for better farm buildings should be initiated wherever conditions become possible. This is as yet practically an untouched field in India for which agricultural engineers should take responsibility.

12. Agricultural engineers should take greater interest in developing equipment for the dairy industry, particularly for the use of the *gwala* and small dairyman. For large scale operations, probably the need is well met by the introduction of standard types of equipment from the West. However, in co-operation with dairy experts, there is need for equipment of a simple type for ghee making and refining in villages, for equipment for the transporting of milk and milk products from the farm to dairy and for the distribution of milk to consumers, for cheap but efficient barn equipment, mangers, animal ties and many other things, to the development of which the agricultural engineer should make valuable contributions.

13. The making of new equipment available to the cultivator is equally as important as the designing and manufacture of it. Many things like smaller implements are suitable for individual ownership. Larger machines, more complicated machines requiring more training or skill for operation or requiring repairs outside the skill and facilities of the village blacksmith will in the beginning at least have to be made available otherwise. Co-operative ownership is often proposed without any clear definition of how it is to be managed Co-operation of a few individuals as partners is almost certain to fail 100 per cent. Co-operative Society ownership and giving on hire for operation by hiring cultivators may be satisfactory in case of the simpler things otherwise suitable for individual ownership but too costly for the use made of the implements,

particularly if adequate provision is made for repairs. I consider it unlikely that the latter condition will be best in the case of relatively small local societies but would welcome experimenting by those who think it will work The most favourable conditions for such experiments will be localities where agricultural engineers can give help and advice to the local society on the selection, purchase and maintenance of the implements. If larger power driven devices such as threshing machines should be introduced, I feel that best results will be gotten if they are owned and operated by the individual contractors who are paid on the basis of work accomplished, but Co-operative Society operation may be successful provided a sufficiently well trained operator is hired and paid a suitable wage—which I again consider unlikely to happen as the society members are almost certain to be tempted to try a cheaper and less skilled operator to the harm of the apparatus and with resulting prejudice against such improved equipment generally. In any case, agricultural engineers should study and where possible experiment with solutions to these problems.

The problem of merchandising improved implements should also have attention in the same connection. I believe it is true that improved implements have been most successfully brought into wide and common use in India where they have been merchandised by private enterprise. Government sales through official channels have to overcome the natural suspicion of the cultivator and the inertia of the paid agent whose income does not depend on results secured. This needs investigation and demonstration or disproval and a reorientation of policy accordingly. The attempt to distribute improved implements cheaply by government agency tends to strangle private enterprise, partly by setting prices below that level at which reasonable profits can be made from the business and by excessive control over types and models allowed to be distributed. In my opinion, every opportunity should be taken to experiment with alternatives to Government merchandising of implements and machinery.

One more suggestion and I have finished. I feel there is great need for more exchange of information and opinion.

I personally feel the need for a technical society in which all who are interested can take part, where in annual or periodical meetings opinions and the results of research and investigation can be freely presented and discussed. Such a meeting as this is of great value to those fortunate enough to be invited to be present. It may be necessary to continue to have such meetings for the formulation of Government policy. I do not think that this meeting takes the place of a technical society in which officials, private individuals interested, those concerned in the trade in implements, can meet and exchange information and views freely on the basis of scientific development and without direct reference to Government policy or opinion. I feel that officials should be allowed to take part in such meetings freely as individuals but not as government representatives and that attendance at such a meeting should not require the taking of leave from their casual or other leave. At present we do not know what is being done by other workers, except by accident. Far too much, each of us has to work alone and without the opportunity of discussing our conclusions with others of similar training and experience. Hence we tend to be and remain provincial in outlook and experience. I should like to see the formation of a society of agricultural engineers which would work for the exchange, perfecting and spread of information and experience in agricultural engineering. I am not thinking of a society whose main function would be the addition of additional initials after the names of members or which would provide offices to which annual elections could be held but rather a society which would serve as a clearing house for information on the developing application of engineering knowledge to agriculture. Such a society actively functioning would be a very great force for the development of agricultural engineering in India.

Cowardice asks, "Is it safe?"
Expediency asks, "Is it politic?"
Vanity asks, "Is it popular?"
But Conscience asks, "Is it right?"

—*Punshun.*

A WRENCH IN THE AGRICULTURAL MACHINERY

By

HENRY S. AZARIAH, Our principal.

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It is said that benefits to humanity from various sciences were being held back due to insufficient knowledge of certain social sciences like Economics and Sociology. This lag of the social sciences had been detrimental to the progress of civilization*. Many of the evils are attributed by some writers to just this. (Principles of agricultural production were quickly mastered and were utilized, while little attention was paid to Agricultural Economics, and Rural Sociology. As a result of this, the physical volume of all commodities increased tremendously, while the exchange system failed†.) Paradoxically in plenty, humanity suffered! While many were in want, nation after nation restricted production and disposed their "surpluses" in a shameful way. Brazil dumped its coffee in the sea; the United States ploughed under some of its agricultural produce, and gave bounty to the farmer for ploughing under cotton and for killing pigs; Holland destroyed its beautiful tulips; and Denmark, like the United States, offered a bounty for killing cattle! Unemployment and strikes became epidemic in all countries: and, because of these, the form of government was questioned: some nations turned to dictators hoping that somehow one man may be all-wise where democratic form of governments have failed.

India also has neglected this important science. During the past twenty-five years a great deal of progress has been achieved in Plant Breeding, Dairy Husbandry, Plant Physio-

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*H. L Barness, Society in Transition, Prentice-Hall Inc. N Y., 1939.

† G.F. Warren and F.A. Pearson, Gold and Prices, John Wiley & Sons, New York, p. 5, 1935.

logy, Agricultural Engineering, Veterinary, Entomology, Agricultural Chemistry and Soil Science*; yet our knowledge of Agricultural Economics as applied to Indian conditions have widened but little. We have emphasized in higher yields and better varieties, but we have not considered the economic aspect of a farm with such crops We have been interested so far, in measuring the success of the farm business in terms of "return per acre" only. While this is a useful measure from the national standpoint for knowing how much we can produce per acre of land available for export and for feeding the teeming millions. it is not a good measure from the farmer's point of view. He needs to know how much his time and labour are worth; and how much the family had earned during the year. With interest in the national policy, we have ignored the farmer and with him, the business side of agriculture. More attention should, therefore, be paid to Agricultural Economics, if further progress is desired in agricultural production: otherwise, it will act as a wrench in the machinery of agricultural industry.

A great deal has been written in this country under the title of Agricultural Economics, which authorities in the United States and in England would not consider as belonging to its domain. "Rural Sociology and Rural Economy have been taken as synonyms of Agricultural Economics. Misnomers like 'Indian Agricultural Economics' have appeared in print. If Agricultural Economics is a science, there cannot be such a subject as that. Agricultural Economics as applied to India does exist: and it is something different. In no other field of science is such a mistake tolerated. We do not hear of an English Physics, a Chinese Mathematics, an American Plant Breeding, or a French Genetics! This war has brought greater unity and exchange of thought between the English speaking countries; and a common understanding of ordinary things in life will result. Scientists and Research workers, therefore, cannot withdraw themselves into the shell of isolationism; and take no notice of what is going on in other countries.

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*The Progress of Science in India during the past twenty-five years, Indian Science Congress Assn., Calcutta, 1938.

This unhappy state of affairs is due to two reasons. The first is with respect to the writers. Persons not directly trained in Agricultural Economics have attempted to write on the subject. The work of some of these men bring them in contact with rural problems; and that had been the excuse. As Lewis H. Haney aptly points out, "From the man in the street to the physician and the lawyer who happens to be running a bank, everyone is apt to think he knows economics These (accountants, statisticians, and engineers) 'professional men' may have had little or no training in economic science. Their work, however, brings them into touch with certain economic problems; so they pose as 'economists'. One big trouble is that there is no test of survival among economists. They go on year after year expressing unsound views and making serious errors, yet they survive and may even be called 'eminent'."* The second, concerns the subject matter. Just what is Agricultural Economics is not clearly understood by many. This may be due to the fact that Agricultural Economics as a science is of recent origin; and these men might have lost touch of the progress in this field that have taken place in various countries, during the last few years. Agricultural Economics as an art, however, existed from the time of elder Cato† and Varro‡, nearly two hundred and fifty years before Christ; but it was recognized as a science, only from the beginning of this century. Perhaps a historical retrospect will make this point clear and will bring out what Agricultural Economics means to-day.

The beginning of Rural Economy may be said to be in 1800, when an university in Germany published a magazine called "Agrarpolitik" (Agriculture in relation to the State and Society). Fifty-one years later, the Institute of Agronomy at Varsailles gave a course in "economic rurale". These early works were in the nature of Rural Economy and not particularly Agricultural Economics, as we under-

*L. H. Haney, Economics in a Nutshell, Macmillan Co , N Y., p. 1., 1933.

†A Virginia Farmer, Roman Farm Management, the treatise of Cato and Varro, Macmillan Co., New York.

‡Storr-Best, Varro on Farming, G. Bell and Sons Ltd., London, 1912

stand today. In 1874, Dean Roberts* of Cornell University (U.S.A.) took an inventory of the cattle and horses belonging to the University. The value of this practice was soon recognized and in the next year all other departments were ordered to take inventories. This incident is important in the history of Agricultural Economics, because farm inventory to-day occupies a central place in Farm Records and Accounts; and, this branch of the science contributes greatly to Farm Management. Also, it is farm inventory that marks one of the differences between Commercial Book-keeping and Farm Records and Accounts, for the term "inventory" as used by the merchant is something different ......No definite contribution was made until the year 1900, when Dean Liberty Hyde Bailey†, then professor of horticulture in Cornell University (U S.A.) made certain field studies which were observational in character. In the same year Ernst Laur ‡, professor of Rural Economy at Zurich Politechnicum (Switzerland) started a simple method of account keeping for research purposes. The Swiss Farmers Union collaborated with him in his efforts. About this time Andrew Boss (U. S. A.) introduced a separate course on Farm Management in the university of Minnesota. Three years later, in 1903, Thomas F. Hunt$ (U. S A.) of the department of Agronomy, Cornell University, collected with the help of his students some data on farm management from farms close to the university. Henry C. Taylor (U. S. A.) published a book called, "An Introduction to the Sutdy of Agricultural Economics" in the year 1905‖. This was written from the point of view of agrarian policies and land utilization, and it had no section on marketing, rural finance, Agricultural labour, and rural taxation. This year was a land-mark in the history of Agricultural Economics, because the United States Department of Agriculture set up a separate office for

*I. P. Roberts, Autobiography of a Farm Boy, L.B Lyons & Co, Albany, N. Y.

†L. H. Bailey, Holy Earth.

‡Encyclopedia of Social Sciences.

$Thomas F. Hunt—data collected by students of Farm Management, unpublished records, Cornell University, 1903.

H. C. Taylor, An Introduction to the Study of Agricultural Economics, 1905.

Farm Management. In 1906, the first detailed survey of farm business was conducted by G. F. Warren in a county* in the up-state New York. This study was extended to another county† next year. These early studies were not very useful as they contained too many details: so, after a lapse of three years (1909), Warren changed his approach to the problem. The new approach was from the farm management point of view, that is, why certian farms paid better than others. The investigation was limited to 600 farms in the Livingston county (N. Y.) but those six hundred farms represented nearly one hundred per cent of the farms in five townships in that county. There was no selection of any sort in collecting the data. It may be of interest to note here that records have been taken of the same six hundred farms once in every ten years. This is believed to be the longest systematic study of this sort in Farm Management, in the whole world. Other studies that have been added in Cornell are kept separate. In 1911, Nixon Carver of Harward University, approaching from the field of General Economics published a book called, "The Principles of Rural Economy‡" W. J Spillman's bulletin on "What is Farm Management' appeared next year§ About this time, Dean Ladd (Cornell University) started Cost Accounts with willing farmers. Agricultural Economics was definitely recognised in England in 1913, when Agricultural Economics Research Institute at Oxford was founded under the direction of C. S. Orwin. The emphasis at the Institute was on cost accounts as a method of research. The Institute is also merited for organised research in marketing. In the same year G. F. Warren of Cornell University published a text-book on Farm Management‖ and seven years later the United States

*G. F. Warren and W. E. McCount, An Apple Orchard Survey in Wayne County, N. Y. (Cornell) Agr. Exp. Sta. bull. No 226, Ithaca, N. Y.

†G. F. Warren and W. E. McCount, An Apple Orchard survey in Orleans County, N. Y. (Cornell) Agr. Exp. Sta. bull. No. 295, Ithaca, N. Y.

‡N. Carver, Principal of Rural Economy, Ginn & Co., Boston, U. S. A. 1911.

§W. J. Spillman, What is Farm Management, U. S. D. A., bull. No. 259, 1912.

‖G. F. Warren, Farm Management, Macmillan Co., N. Y., 1913.

Department of Agriculture set up a separate office of the markets. Another text-book on Farm Management* was published by W. J. Spillman in the year 1923. In Denmark, Larson, Professor in Royal Veterinary and Agricultural College, Copenhagen, organised sixty Co-operative Book-keeping Societies in 1926. These accounts were kept by paid consultants employed by the co-operatives; and very valuable information was secured. The year 1926 was another land-mark in the history of development of Agricultural Economics; it was the year in which the first International Conference of Agricultural Economists† met at Dartington Hall, Devon, England, under the presidentship of Mr. Leonard K. Elmhirst. It was also the year in which the first issue of the Journal of Farm Economics—the organ of the American Farm Economic Association appeared.

Agricultural Economics, then, has come to be recognized rather recently as a separate branch of social science and because the subject deals with practical problems the emphasis had been different in different countries. England has stressed "Costings" (Cost Accounting) and marketing; Denmark, Switzerland, and Sweden, Farm Accounts; Italy, land and income valuation; France, Rural Law and legislation; Germany, Rural Credit, Co-operatives, land tenure, and land settlement; ~~and the~~ United States, Farm Management, Marketing and Prices. This, therefore, does not mean that Agricultural Economics means something different in different countries. On the other hand, it indicates the various divisions of the subject, and several particular interests, especially Farm Management, Rural Credit, Marketing, and Land Policy from which this business Phase of farming has developed. Agricultural Economics to-day includes, Agricultural Geography, Farm Management, Farm Records and Accounts, Farm Appraisal, Farm Finance, Co-operatives, Marketing, Agricultural Prices, Agricultural Statistics, and Land Policy including rural taxation.

Thus, although the two important phases of agriculture are Farm Management and Marketing, Agricultural Econo-

*W. J. Spillman, Farm Management, Orange Judd, N. Y., 1923.

†The Proceedings of the First International Conference of Agricultural Economists, the Colgate Press, Mensha, Wiscon., U. S. A., 1929.

mics covers the whole field related to the farming business. It may be relevant to mention in this connection that the unit of study in Agricultural Production is an enterprise; that in Farm Management, the whole farm; and that in Agricultural Economics, the whole field of sciences dealing with the business side of farming, while that in Rural Economy, the whole industry of Agriculture, from a national stand point. In certain colleges practical training in Farm Management is said to be given to students by allowing them to farm a small plot of land in the main college farm. When the unit of study in Farm Management is the *whole farm*, how could the subject be learnt under such conditions? Another university is treating Farm Management as belonging to the field of Agronomy; and, it is not offering any course on the subject to students specializing in Horticulture or in Dairying, as if business problems concerning the whole farm do not occur in fruit-farming or in dairy-farming! One of the students who underwent such a special training in this university was refused employment because he had not taken a course in Farm Management.

Farm Management holds a very important place in Agricultural Economics; and, this branch of the science has been greatly neglected in this country. Temendous effort has to be made by everyone interested to spread correct information on this subject, which is vital to the progress of agricultural industry. Being a practical subject adequate progress cannot be made unless it is based on research. *This must be done by men trained in that subject.* This is important, as those not trained directly in the subject are likely to miss the essentials in the problems. Every College and University offering a degree in agriculture should make an effort to conduct scientific research in Agricultural Economics. An important work like this cannot be neglected by either the provincial government or the central government; and, without adequate help from the government the present financial condition of many of the educational institutions will incapacitate them from doing their best.

OBSERVATIONS ON BRINJAL BORER, *LEUCINODES ORBONALIS* GUEN, AT THE ALLAHABAD AGRICULTURAL INSTITUTE FARM.

BY

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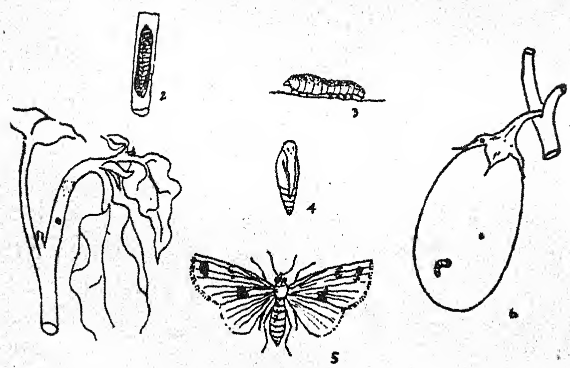
Leucinodes orbonalis Guen. is a pyralid moth whose caterpillars bore into the young shoots and fruits of Solanum melongena (brinjal). Hence it is also known as the shoot and fruit borer of brinjal. It is quite common all over India including the United Provinces; and here at Allahabad it is sometimes a very bad pest. During years of heavy attack not a single plant escapes from the infestation of this pest. The adult is a medium-sized moth, a little over 2 c.m., in wing expanse. The colour of the four wings is creamy and they are mottled with brownish-red and dark-brown marks. The hind wings are whitish with a few very fine dark spots. The female moth after mating, lays eggs singly on the tender shoots and fruits which hatch into tiny caterpillars in about three days. These little caterpillars in the young stages



1. Attacked shoot. 2. Borer inside the stem. 3. Caterpillar. 4. Pupa. 5. Moth. 6. Affected fruit.

of the plant at once bore into the young stems and start feeding inside them with the result that the shoots droop down and wither. Later on when the fruits appear, they are also attacked. The caterpillars are full fed in about two weeks when they are about 2 c.m. long and 3 m. m. in diameter and have a pinkish colour. They are common in attacked brinjal fruits and are quite a familiar creature to the housewife. The caterpillar pupates in dark brown cocoons usually outside near the mouths of the holes in the shoots and fruits. The pupa stage lasts for about a week or more when the new moth comes out.

The attacked brinjal plants wither and sometimes die or get stunted. The attacked fruits become useless for human consumption. The best way to get around this insect pest is to remove and collect all the affected shoots and fruits and see that the insects inside are destroyed. This can be done by dumping them into boiling water and later on making use of the material for compost making or burying them deep in the ground or burning them along with some dried material like hay, etc.

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" Where grows the golden grain ?
" Where faith ? Where sympathy ?
" In furrows cut by pain ?"

FUN WITH YOUR CAMERA

By

A. F. Bollinger.

Christian Rural Fellowship.

I have never been very enthusiastic about using such sets of lantern slides on rural reconstruction as are available commercially. Most of them seem to have their setting in the Punjab or some other place that is equally foreign to the villager of Western India. The villager sees the strangeness in dress, the different style of house construction —and often seems to miss the point of the story.

Several years ago I determined to make up my own set of slides. With this aim in view I bought a medium-priced 35mm miniature camera. Then I began looking for things to shoot. I especially wanted sequences—not just isolated shots. I visited one village where good work is going on and took pictures right and left. Then in my touring work I kept my eyes open for clean homes, prize babies, well-tended fields, kitchen gardens, school gardens, improved poultry and cattle, as well as dilapidated homes, eroded fields, neglected school houses, and poor livestock.

From these negatives I had "diapositives" printed. These are positive prints on transparent film, and cost from one anna to six annas, depending upon where you get them done. These prints were masked, mounted between glass and bound with tape to make the miniature 2″ × 2″ slides.

Making miniature slides from 35mm negatives is the simplest and cheapest way to make slides, but of course any size camera may be used, and either large or small slides can be made by either enlarging or reducing the print according to need.

I have found that the village people take a keen interest in these slides, which are of people whom they know or at least whose village or district they know. It is therefore easy for them to make comparison with conditions in their own village. I also feel that it helps the people of the same

mission or church area to get acquainted with conditions in other parts of the field. And what pride village people take in seeing themselves on the silver!

Since starting this work I have entirely discontinued taking any private "photos", in spite of earnest promises to pay. Now-a-days when anybody asks me to take his picture, I tell him my camera is dedicated to a cause. I further say to him, "Show me something you are doing that is worth taking, and I will take your picture and show it on the screen to all your neighbours.

I use a Kodaslide projector which is operated by an automobile battery. The greatest difficulty I have experienced is in getting the battery properly charged. The answer to that problem seems to be a hand or foot-cranked generator.

I find this kind of picture-taking lots of fun and feel that my camera is justifying its existence by doing a useful job.

AN EASY WAY TO CLEAN WINDOWS

Take a piece of soap and dissolve it in a little warm water, just enough to make a fairly thick soap solution. Into this solution mix enough finely sifted air slaked white lime to make a very stiff paste, as thick as can be stirred to mix well. Any dry powdered white lime will do but it should be finely sifted and not gritty.

To wash the windows, smear this paste on the glass with a small piece of moistened cloth to thoroughly cover the glass. Only a thin film need be used but the whole glass should be covered. Allow it to dry completely, then rub off the film of powder with a soft cotton or linen cloth and the window should be bright and shiny.

If desired, the paste can be molded in a simple form and allowed to dry into a cake from which material can be rubbed with a damp cloth as needed or it can be just kept in some shallow tin or box. Very little is required and if it dries out, only water is lost and no harm is done It should keep indefinitely.

METHOD OF MAKING JELLIES FROM DIFFERENT FRUITS*

By

A. Dayal Chand, M.A., B. Sc. (Ag.), F. R. H. S.

22. Quince Jelly.

The quince is poor in acid and pectin content, therefore it is not suitable for the purposes of making jelly unless the essential ingredients are introduced. If quince juice is cooked alone with a desirable amount of sugar it forms a slimy and stringy syrup which sheets off even at a comparatively low temperature giving clear indication of the jelling point, but when it is cooled it remains syrup. With this fruit the "sheeting test" cannot be relied upon.

Although the quince is poor in acid and pectin, its flavour is so strong that a combination of quince with an equal part or even twice as much sour apples leaves its distinct flavour in the jelly. The combination of apple not only improves the flavour and texture, but it also imparts a rich red colour to the jelly.

The quince, due to its strong flavour, lends itself to combinations with all those fruits which lack flavour, but are rich in acid and pectin.

Quinces are very tough fruits and require long cooking. As they have a strong flavour which may be lost due to prolonged cooking in an open pan, it is therefore desirable to cook them in a covered pan or in a pressure cooker.

Process:—Select good sound quinces and apples. Weigh and wash them. Cut them into slices and cook separately with three times as much water. Strain the juice and mix equal amounts of quince juice and sour apple juice and make jelly according to the directions given for apple jelly.

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*Continued from previous issues of the Allahabad Farmer.

23. Peach Jelly.

The peach is another fruit which has received the close attention of horticulturists in many countries of the world. Several varieties have been evolved, but they can be classed into flat and round varities, according to their shape. The large round varieties are usually used for canning and the flat sweet varieties for ordinary table use, but there are other varieties with a lesser amount of pulp and a slightly astringent taste which are not suitable for table use but can be used for making jam and jelly. The commercial varieties of peaches can be used for this purpose provided they are available at cheap rates.

Almost all commercial varieties of peaches are deficient in both acid and pectin, and ordinary sour varieties are poor in pectin, but they possess a strong characteristic flavour which lends itself to the making of jelly if the deficiency is made good by either adding commercial or home made acid and pectin or blending other fruits which do not have a strong flavour, but are rich in acid and pectin.

Process.—Sort out firm peaches free of all blemishes. Wash them thoroughly, discard the stone and cut them into pieces. Add one part of lemon slices to three parts of peaches and cook them in twice as much water for about 20 minutes or until the slices become soft, and strain the juice without using pressure.

Take a desirable quantity of juice, and let it boil for 3 to 5 minutes. Add two and a half pounds of sugar to every three pounds of juice. Cook rapidly over a strong fire, removing the scum as it collects. When the end point is reached, remove it from the fire and pour the jelly at once into sterilized containers and seal as usual.

24. Kaitha Jelly.

Feronia elephantum or wood apple is commonly known as kaitha. It is a tree of as large a size as the mango and grows wild. When the kaitha reaches full maturity it bears fruit in very large number, but very little use is made of them. Only a few of them are used for making chutney

and that also in a very crude manner, by crushing the pulp with salt and chillies. Otherwise they have no commercial value and are simply wasted.

This fruit, when it reaches maturity, is very rich in both acid and pectin, therefore it makes very firm jelly. Due to its richness in essential ingredients and strong flavour it can be combined with several other fruits. The fruits which are usually combined with it are mangoes, guavas, jujubes, quinces and others which are low in one or both the essential ingredients.

The fruit of the kaitha has a very hard shell which may be broken with a hammer. The stringy pulp is scraped off the shell, and is used for making jelly.

Process:—Select only the well-ripened fruit, because immature fruits fail to give jelly. Break their shell and collect the brownish stringy pulp, which is slightly slimy in nature. Weigh it and cook it with three times as much water as fruit by weight for about half an hour. Strain the juice through a thick jelly-bag without pressing. Allow it to stand overnight and drain off the clear juice leaving the sediment behind.

Take a desireable amount of juice, bring it to a boil and skim off the precipitation before it actually starts boiling vigorously. As kaitha juice is very rich in acid and pectin, add an equal amount of sugar by weight. Dissolve the sugar by stirring and remove the scum before it begins to boil. As kaitha juice is very cloudy, it should be cleared by the addition of powdered alum, while the juice is boiling. Continue boiling the juice rapidly until the end point is reached. Pour the jelly into sterilized jars and seal.

25. Kaitha and Guava Jelly.

Guava juice lacks acid and is low in pectin; therefore pure guava jelly cannot be made well unless acid is added to it. The most common method practised in the bazaar for making the so-called guava jelly is to mix guava and kaitha juices in equal proportions. Because the guava has a much stronger flavour than the kaitha, the jelly has a guava flavour

and the product is often sold as pure guava jelly. The combination of guava and kaitha however yields an excellent jelly of firm texture which keeps for a long time.

Process:—Extract the juices of the kaitha and guava separately as previously described and mix them in equal proportions Take a convenient amount of the mixture, bring it to a boil and add two and a half pounds of sugar to every three pounds of juice. Follow the same directions as given for kaitha jelly.

26. TOMATO JELLY.

The tomato is considered to be the king of all vegetables, being rich in vitamines and other elements, which tone the human body from childhood even to old age. It is indeed inferior to none in health giving properties "An apple a day keeps the doctor away," falls short before the saying "A tomato a day keeps the doctor away." Tomatoes should therefore be made a permanent constituent of daily meals. The difficulty is that they cannot be had fresh throughout the year. This difficulty can be overcome by preserving tomatoes in one form or another. Preserved tomatoes do not lose much vitamines and other essential properties but add to the palatability of the meals. Many preparations made from tomatoes will be described in their proper place.

Tomato juice is rich in acid, but lacks pectin and therefore jelly cannot be made from it unless pectin is added in one way or another. If commercial pectin is available, well and good, otherwise add one pound of albedo (white portion) of lemon or *khatta* to every eight parts of tomatoes. Crush the tomatoes and cook both tomatoes and albedo in their own juice for about fifteen minutes. Strain the juice through a jelly-bag.

Process.—Take three pounds of juice, put it on the fire and when it begins to boil, add two and a half pounds of sugar and dissolve it by stirring. Remove the thick layer of scum just before the juice starts boiling. Strain the syrup to remove impurities. Return the kettle to the fire and continue cooking until the juice "sheets off." Pour the boiling hot jelly in sterilized jars and seal.

27. Apricot Jelly.

Apricots are rich in acid but deficient in pectin in the ripe stage. They have a reliable pectin content when they are just reaching maturity. So in order to get good jelly, apricots should be used when they are fully developed and are still hard.

Process.—Select good firm apricots, weigh, wash, and cut them into small pieces. Add double the amount of water and cook them for about twenty minutes or until the slices are cooked to pulp. Crush the slices in order to get an extract rich in pectin. Strain the juice allowing it to drip without pressing. Conduct a pectin test and if the juice is deficient in pectin add a suitable amount of home-made pectin, or blend fruit juice rich in pectin.

Take a desirable amount of juice, and bring it to a boil. Add to it two and a half pounds of sugar to every three pounds of juice and dissolve it. Continue boiling rapidly until the jelling point is reached. Pour it into sterilized hot containers and seal.

28. Jamun Jelly.

Jamun or *Eugenia jambolanum* is a dark purple fruit. The ordinary country variety has comparatively little pulp and a large stone, but the improved varieties have more pulp and smaller stones. This fruit is green in the young stage, but gradually turns red, purple and finally dark-purple at full maturity. It is rich in acid and pectin at full maturity, but the pectin hydrolyses as the fruit softens.

Process.—Select tart varieties of jamun when they are fully matured but have not turned soft. Discard all bruised and diseased fruits. Weigh and wash them under a tap. Cook them in equal amounts of water for about twenty minutes, until the pulp leaves the stones. Strain the juice through a thick jelly bag without pressing.

Take three pounds of juice and put it on a fire. When it just begins to boil, remove the scum and add two and a half pounds of sugar. Continue boiling rapidly until the juice "sheets off" from the spoon. Pour the boiling hot jelly into sterilized hot jars and seal.

29. Loquam Jelly.

Loquat or *Eriobotrya japonica* is usually a round golden yellow fruit. It is rich in acid and medium in pectin.

It makes very good jelly in the hard stage, but fails to jell if the fruits are over-ripened and soft.

Process.—Select well ripened, but still hard and sound loquats. Remove the stems and reject the blemished fruits. Wash and remove the stones by cutting the fruits into halves. The fruits may be cooked without removing the stones, but they require a longer period of cooking which impairs the texture and flavour of the product. To each volume of slices add twice the volume of water and cook it over a strong fire in a covered kettle for about twenty minutes until the fruit is cooked to a pulp. Crush the fruit, boil it a few minutes and strain the juice without pressing.

Take three pounds of juice and when it starts boiling add. to it two and a quarter pounds of sugar and dissolve it by stirring. Remove a thick layer of coagulated organic matter before the juice again starts boiling. As the loquat juice is rather cloudy, precipitate the rest of the organic matter by adding a little bit of powdered alum and skim off occasionally. Continue boiling until the end point is reached. Remove the kettle from the fire and pour the jelly into sterilized hot jars and seal.

30. Plum Jelly.

Plums are generally of two colours, red and golden yellow. Both of them are excellent as regards their properties for making jelly. The red kind is, however, preferred because it imparts a red colour to the juice which gives a brilliant colour to the jelly and thus is more attractive.

Plums are rich in acid and have sufficient pectin to produce a jelly of excellent texture, if they are used when fully matured but still hard. The pectin content of the fruit deteriorates when the fruits turn quite soft.

Process :—Sort out hard and fully matured plums. Cut off the bruised portions and reject the rotten ones. Wash off the adhering dirt under running water. Remove the stones by cutting the fruit into halves and cut them further into two pieces each. Weigh the fruit and add. three times as

much water as fruit and cook them for about half an hour until the fruit is cooked to a pulp. Crush them and boil for a few minutes. Strain the juice through a jelly-bag without pressing.

Take a convenient quantity of juice, put it on the fire and when it just starts boiling, remove the scum and introduce two and a half pounds of sugar to every three pounds of juice. Dissolve the sugar, remove the scum before the juice again boils. Add. a little powdered alum to clear the juice. Continue boiling rapidly, skimming off occasionally, until the jelling point is reached. Pour the jelly in sterilized jars and seal.

31. Aonla Jelly.

The aonla or *Phyllanthus emblica* is another stone fruit which is highly esteemed from the medical point of view. The peculiarity of this fruit is that it remains very hard long after reaching maturity, so there is not much danger of its losing pectin unless the fruit is rotten. The aonla is rich in acid and medium in pectin content, and therefore it yields very good jelly without the addition of any of these ingredients.

Process:—Select sound aonlas, reject the rotten ones and cut off the bruised parts, if any. Wash the fruit and cut it into very thin slices, because this fruit is very hard and would require prolonged boiling if not cut. The slices can be softened either by prolonged boiling in a large volume of water which is not desirable or more rapidly by boiling in water containing a small percentage of sodium carbonate or ammonia. The slices may also be cooked in an adequate amount of water in an autoclave under ten to fifteen pounds pressure. Under ordinary home conditions cook the fruits in four times as much water as fruits by weight and cook them rapidly in a covered kettle for about an hour. Crush the fruits to a pulp during cooking. Strain the juice without pressing.

Take a convenient amount of juice, bring it to a boil and add two and a half pounds of sugar to every three pounds of juice and boil it to the jelling point as previously described. Pour the jelly into sterilized jars and seal.

ON THE TERATOLOGY IN MAIZE*

By

SAIYID RAZI HAIDER NAQVI, B.SC. (*Agri.*)

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A cultivator had exhibited an abnormal maize plant in the mela held at Singeswarasthan, Madhepura. It had 8 huskless ears each of which had a shank approximately 12 inches in length. The visitors were very much astonished to witness this material. In our previous contributions, it has already been mentioned that a great number of recessive abnormalities are often met with in self-pollinated strains of maize and most of these have been fully described by several scientists of other countries. With a view to make the readers of our Journal "Kisan" more familiar with some of the important anomalies and for the facility of some non-technical judges in such exhibitions a few of them are presented below:—

In the book on corn written in 1904, it has been mentioned that even the appearance of ears at the juncture of each leaf with the stalk had probably been observed. Later on Barth-Davy and Joseph (1914) recorded the occurrence of bisexual ears or the development of secondary ears from the nodes of a shank at a distance of about 3 · 4 inches from the stem. Emerson (1920) found that the tillers of various varieties of corn generally end in ears or have tassels the central spike of which bears a terminal cob. Wallace and Bressman (1925) in the book "Corn and corn growing" have mentioned that the ears developing tassels are known to occur frequently. Schaffner (1927), Phipps (1928) and Hayes, Johnson and Crim (1931), noted a very great number of recessive abnormalities in self-pollinated strains of maize. Richey and Sprague (1932) threw some light on the factors affecting the reversal of sex expression in the tassels of maize and Schaffner (1927) attempted to control such characters in Indian corn.

*Translated and reproduced from Hindi 'Kisan' Vol. 9, Part 3, June 1941, pp. 15-16 with the addition of references kindly supplied by the author.

It is therefore, evident from the foregoing that maize is a very plastic crop and exhibits a variety of monstrosities so very rare in other crops. In this connection, it would not be out of place to mention that an interesting case of an abnormal tassel (Fig. I) was observed in 1938 by the present writer at the Government Farm, Kanke, Ranchi.

Fig. I.
Right to Left.
1. Tassel with cob. 2. Cob with tassel. 3. Developed tassel 4. Cob with tassel.

From the perusal of the above figure, it would appear that the topmost node of the maize plant gives rise to two ears each of which develops tassels and at the same time produces two separate tassels one of which bears a terminal cob. Anomalies of a similar nature have been observed separately by some scientists as indicated above, but in the present case several abnormalities are found in the same specimen.

With a view to study the heritable nature of the teratology under reference, seeds of this specimen were sown in the subsequent year, but no clear-cut results emerged as from the total of 180 plants only one bore a tassel the central spike of which produced a terminal cob. There was, however, another plant which had a peculiar tassel and at the same time developed an ear in its root zone (Fig. II). The tassel in this case consisted of a number of unfilled ears, some of which had produced tassels.

Fig. II.
1. Right tassel.
2. Left-cob in root zone.

The other branches of the tassel bore more or less distichous rows of staminate spikelets arranged in pairs as usual but the empty glumes had much enlarged and appeared to be small leaves rather than glumes. Most of the spikelets possessed no stamens but there were a few others which had stamens that were devoid of pollen. Gerhadt (1929) and Singh (1930) have recorded the occurrence of vegetative buds on the roots of milk weed and gram respectively, but their actual function is not yet known. The small ear in the root area of maize plant met with here was more or less normal with the exception of the shank which had become too weak due to its remaining constantly under moist earth.

My sincere thanks are due to Dr. A. K. Mitra, Economic Botanist, U.P., for examining the material and to Dr. B. P. Pal, Imperial Economic Botanist, New Delhi, for suggesting some valuable literature on the subject.

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SON OF THE SOIL *

By

DWARKA PRASAD PERSAI

Agricultural Research Institute, Nagpur

No trump or beat of drums announce his birth,
Nor sumptuous presents in his honour given;
In humble solitude he comes to earth,
To strife, to poverty, from peace of heaven.

Under the care of sun and moon he grows
In mind and bone and flesh with passing days.
The wind, the rain, the dust, the trees he knows,
Tasting the joy of naked childhood's ways.

Before he steps from childhood's tender years,
To cattle and the plough he puts his hand.
His worn old father parts his load of cares
And shares the joys and sorrows of the land.

And soon alone, with hard hand on the plough,
He treads from dawn to dusk life's furrow long.
The heat and thunder give no respite now—
He struggles without rest and without song.

His hunger yet unfilled, he bears the sheaves;
Forever may he sow, but never reap.
Worn by his worried journey, life he leaves,
Soon in the dust, the kindly dust, to sleep.

All honour from our grateful hearts to thee—
Life-giver, thou, from out thy pain and death.
Our minds and hands and toil to make thee free
We pledge to thee so long as we draw breath.

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* Originally written by Mr. Dwarka Prasad Persai and revised by Professor Norvin Hein, Ewing Christian College, Allahabad.

A Book Review

A New Book for gardening enthusiasts *reviewed by The Home-Making Department, Allahabad Agricultural Institute.*

"People who cannot feel magic persist in believing that gardening is all weeding and manuring - all digging and backache, and so they miss the lights of fairyland," quotes Agnes W. Harler in her new book, "The Garden in the Plains," published by the Oxford University Press, Indian Branch.

Gardening in India is fun, claims the author, because Indian flowering trees, shrubs, and creepers are so brilliant and varied that experimenting with broad colour effects is possible. Plants grow so quickly that one has a chance to play with a garden in a way impossible in colder climates where plants grow slowly.

If you have moved into an old bungalow with a well-established garden, possibly weedy and grown ragged, the author suggests that a thorough cleaning up, pruning of plants, cutting of grass and weeding of paths will promptly make the outlook more cheerful. Then she asks that you take stock of the good features of the garden, deciding which should be retained, and explains the details of renovating old plants and grass, thinning out flower beds, repairing or installing garden ornaments, pergolas, or climbers for vines, setting out hedges, and laying paved, brick, or stone paths. But she suggests that if you are to be in the house only a short time, you should concentrate less on large, permanent features, and more upon growing annual flowers really well. They give a quick return for trouble and expenditure, and are spectacular if massed boldly in beds cut on broad lines.

If you are confronted with a bare, new plot of ground to green over, the author tells you how to draw up a plan and cause your dreams to quickly materialize. The essential features of a garden are a drive, paths, a good hedge round about, and a restful green lawn, and in the background,

grouped in corners, and near the edges should be trees, shrubs, and climbers, flower beds and borders, a plot for vegetables and fruit trees, and compost pits to ensure a good supply of organic matter for fertilizing.

When designing a garden, the author explains, there are two main objectives to keep in mind. The first is to create an effect of spaciousness with the illusion of far boundaries. A well-kept grassy area unbroken by flower beds, unnecessary paths, or too many trees and shrubs brings about this feeling of space. The second point is to plan the garden so that all its features are not on view at a single glance. There is a tremendous fascination about the half-seen in a garden, the hint that there is something more to come just around the corner, such as a shady seat, a pool, rockery, or a summer house partially veiled by the branches of a small flowering tree. In small gardens it is best to keep the general design simple and avoid over-crowding. Plant perhaps only one tree, a curving shrubbery in the background, and a few beds of annual flowers surrounding a special feature, such as a sundial, in a corner or at one end The author tells how to make the best use possible of any special features of the plot, such as sloping ground, terraces, a tank, or a low, marshy area. In planning a garden it is important before you start work to know clearly in your mind just where each plant and feature of the garden will be.

It is useless, the author contends, to garden in fits and starts and then to expect good results. A garden needs continuous care throughout the year, and there should be a programme of work arranged so that every plant and corner of the garden gets its proper share of attention.

Various interesting suggestions are included, such as maintaining a simple fernery. An Indian fernery is an attractive place, cool and restful, in which to potter while the outside world bakes and sizzles. There are many types of ferns to collect, and a variety of glowing foliage plants available to mass against the green background.

"The colourful rockery with true rock plants is not found on the plains of India. Many decorative rock plants cannot

survive the heat, while in some districts rocks and stones are difficult to procure. The Indian version of a rockery, however, can be very beautiful. Ferns and creeping herbs take the place of rock plants proper, and some colour can be introduced by foliage plants, dwarf shrubs, lilies, or annual flowers.

"In India people are ofetn afraid of making a water garden because it may breed mosquitoes. It would be unwise, perhaps, to make a pool in a notoriously malarious district, but in many places there is no undue risk provided certain precautions are taken.

"Climbers may be shown off by being grown as screens, twined around pillars, up trees, or along a pergola. If the compound is big enough and the climate suitable, it is pleasant to introduce a touch of the wild or exotic into the garden by growing a clump or two of tall grasses or perhaps a group of palms."

In this complete gardener's text instruction is given in planting and caring for flowers, trees, shrubs, grass, vines, and vegetables. Extensive lists of annual and perennial flowers, shade, ornamental, and fruit trees, palms, ferns, and ornamental grasses, shrubs and vines, hedges, lawn grasses, vegetables, and fruits are included. Special sections are devoted to roses, chrysanthemums, cannas, orchids, and bougainvilleas. In listing plants the author describes their colour and type of bloom and foliage, berries or fruit, gives maximum height and blooming season, suggests suitable climatic conditions, and includes notes on special requirements or habits of the plant.

The last chapter is a good gardening calendar. One chapter is on suitability of flower arrangements, one deals briefly with vegetable and fruit preservation and recipes, and one explains the identifying characteristics of birds, one might expect to see in the garden.

This book, published by the Indian branch of the Oxford University Press, is commendable as the basis of a course of study in gardening, and would be of great help to any home-maker.

W. B. Hayes, Head of the Department of Horticulture of the Agricultural Institute, after looking over this book, has commented that it is better than the average gardening guide. But although many gardening shibboleths have been excluded, a number of inaccurate statements in regard to mulching, fruit tree pits, fertilizer, exact plant classification, and a few miscellaneous facts, have crept past the censor. A list of his corrections and criticisms is on file with the Secretary of the Home-Making Department, and may be obtained upon request by anyone interested.

SHIRLEY STRONG.

Unanswered Prayers.

Like some schoolmaster, kind in being stern
Who hears the children crying o'er their slates
And calling, 'Help me, master!' yet helps not,
Since in His silence and refusal lies
Their self-development, so God abides
Unheeding many a prayer. He is not deaf
To any cry sent up from earnest hearts;
He hears and strengthens when He must deny.
He sees us weeping over life's hard sums;
But should He give the key and dry our tears,
What would it profit us when school were done
And not one lesson mastered?

What a world
Were this if all our prayers were answered. Not
In famed Pandora's box were such vast ills
As lie in human hearts Should our desires,
Voiced one by one in prayer, ascend to God
And come back as events shaped to our wish,
What chaos would result !

Pray on, sad heart,
That which thou pleadest for may not be given,
But in the lofty altitude where souls
Who supplicate God's grace are lifted, there
Thou shalt find help to bear thy daily lot
Which is not elsewhere found.

ELLA WHEELER WILCOX.

UNITED PROVINCES DEPARTMENT OF AGRICULTURE—MONTHLY AGRICULTURAL REPORTS

FEBRUARY, 1942

I—Season.—During the month under report there was general and widespread rain. For this time of the year it was particularly heavy in the 2nd and 3rd week of the month in almost all the districts of the province. In several places heavy rain was accompanied by hail and followed by strong wind.

II—Agricultural operations.—Agricultural operations are generally up to date. Pressing of sugarcane and preparation of *gur* are in progress. Sowing of sugarcane and extra crops has started at many places. Preparation of land for sowing of sugarcane continues. Harvesting of gram, wheat, peas and mustard has also commenced. The late winter rains have favoured the preparation of seed bed for sugarcane and the sowing of catch crops.

III—Standing crops and *IV—Prospect of the harvest.*—The condition of the standing crops and the prospects are on the whole fairly satisfactory. The general estimate of the outturn of *rabi* crops is expected to range between 75 and 80 per cent. of the normal.

V—Damage to crops.—Slight damage to crops from hail storms is reported from the Muzaffarnagar, Meerut, Muttra, Etah, Bareilly, Pilibhit, Farrukhabad, Fatehpur, Cawnpore, Allahabad, Jaunpur, Basti, Azamgarh, Lucknow, Unao, Rae Bareli, Kheri, Fyzabad, Bahraich, Partabgarh and Bara Banki Districts, while the damage from hail in the Mainpuri, Etawah, Banda, Hamirpur, Jhansi, Jalaun and Sultanpur Districts is reported to be fairly heavy. Some damage is also reported due to excessive rain and continued cloudy weather from the Budaun, Ghazipur, Azamgarh, Rae Bareli and Kheri Districts.

VI—Agricultural stock.—The condition of agricultural stock is on the whole fairly satisfactory, though cattle

disease is reported from certain districts. The following figures furnished by the Director of Veterinary Services, indicate an improvement over the previous month's figures. Hæmorrhagic septicæmia, however, has further increased to some extent:

Disease	January, 1942		February, 1942	
	Affected	Death	Affected	Death
Rinderpest	832	521	495	239
Foot and mouth	832	2	1,050	1
Hæmorrhagic Septicæmia ..	195	145	318	305

VII—Pasturage and fodder.—Pasturage and fodder are reported to be sufficient everywhere except in the Muttra, Mainpuri, Jalaun, Rae Bareli and Sultanpur Districts, from where some scarcity is reported.

VIII—Trade and prices.—As regards the prices of the chief foodgrains, those of wheat, barley, gram and *arhar dal* have risen slightly, while rice shows a decline. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month :

	End of January, 1942	End of February, 1942
Wheat	5·341	5·623
Barley	3·602	3·920
Gram	4·165	4·484
Rice	6·881	6·750
Arhar dal...	5·241	5·332

IX—Health and labour in rural areas.—The condition of agricultural labour is fairly satisfactory. Stray cases of plague and small-pox are reported from certain districts.

MARCH, 1942

I—Season.—Almost all the districts of the province received light showers of rain during the first week of the month. During the remaining part of the month there was no rain except a few showers in the Almora and Garhwal Districts.

II—Agricultural operations.—Harvesting of the *rabi* crops is in full swing with simultaneous threshing in some districts. Sowing of sugarcane and extra (*zaid*) crops is in progress in a number of districts, while early sown extra crops and sugarcane are being irrigated and hoed. Yet in other districts preparation of land for sugarcane and extra crops still continues. Transplantation of tobacco and the crushing of canes is in progress in some of the districts. Planting of potato and ginger is being done in the Dehra Dun District.

III—Standing crops and IV—Prospects of the harvest—The condition of the standing crops and the prospects of the harvest are on the whole fair, except in the areas affected by hail storms. The estimated outturn of the *rabi* crops is between 75 and 80 per cent. of the normal. The mango crop is reported to be fairly good in the majority of districts and is estimated at 14 annas in a rupee The *mahua* crop is also satisfactory.

V—Damage to crops.—Slight damage to crops by hail in the Bulandshahr, Shahjahanpur, Allahabad, Hamirpur, Mirzapur (Dudhi Tahsil), Lucknow (Malihabad Tahsil), Hardoi, Fyzabad and Bahraich Districts, and serious damage in the Jalaun (Jalaun, Kalpi and Orai Tahsils), Rae Bareli and Sitapur (Misrikh and Bisan Tahsils) districts is reported. A somewhat serious outbreak of fire resulting in a loss of Rs. 4,681 is also reported from the Moradabad District. To a lesser extent, damage by fire is also reported from the Aligarh, Cawnpore and Kheri Districts Untimely rain in the Ghazipur and Hamirpur Districts and strong wind in the Muttra District have damaged the standing crops to a slight extent.

VI—Agricultural stock.—Cattle diseases are reported from some of the districts, but the condition of agricultural stock is, on the whole, satisfactory. The figures furnished

by the Director of Veterinary Services, United Provinces, tabulated below compared with those of the last month indicate more seizures and deaths by rinderpest and foot-and-mouth disease. Seizures and deaths by haemorrhagic septicaemia is on the decline.

Disease	February, 1942		March, 1942	
	Affected	Deaths	Affected	Deaths
Rinderpest	495	239	1,001	706
Foot-and-mouth .. .	1,050	1	1,670	13
Haemorrhagic Septicaemia .. .	318	305	281	258

VII—Pasturage and fodder.—No scarcity of pasturage and fodder is reported from anywhere except in the Muttra and Agra Districts.

VIII—Trade and prices.—There has been no marked fluctuation in the prices of wheat, barley and gram, though a general downward trend is noticeable. Rice prices have gone up. The prices of *arhar dal* have been more or less stationary with a slight rising tendency. A comparative statement of the retail prices, in rupees per maund prevailing at the end of the last month and at the end of the month under report is given below :

	End of February, 1942	End of March, 1942
Wheat	5·623	5·392
Barley	3·920	3·503
Gram	4·484	4·246
Rice	6·750	7·320
Arhar dal	5·332	5·356

IX—Health and labour in rural areas.—The month under report was a busy period and there was ample employment for labour in rural areas Outbreaks of smallpox are reported from the Etah, Pilibhit, Ghazipur, Azamgarh, Sitapur, Kheri and Fyzabad Districts. Stray cases of plague and cholera have also been reported In an outbreak of fire in the Moradabad District eight persons lost their lives. The condition of the labouring classes is, on the whole, satisfactory.

APRIL, 1942

I—Season.—During the month under report there was fairly general rain. It was heavier in the 2nd and 3rd weeks than in the first week. The fourth week was rainless. Twenty-one districts recorded rainfall above the normal.

II—Agricultural operations.—Agricultural operations are generally up-to-date Sugar-cane and extra crops are being irrigated. Threshing and winnowing of rabi crops are in progress. At places the land is being prepared for cotton and *chari.* Preparation of land for kharif and the sowing of early kharif crops has begun in the Dehra Dun District.

III—Standing crops and IV—Prospects of the harvest.—The condition of the standing crops and the prospects of harvest are, on the whole, satisfactory.

V—Damage to crops.—Slight to moderate damage to crops by hail is reported from the Bulandshahr, Agra, Mainpuri, Etah, Budaun, Etawah, Garhwal, Sitapur, Hardoi and Kheri Districts. A somewhat considerable outbreak of fire resulting in a loss of Rs. 1,875 and Rs. 3,000 respectively is reported from the Aligarh and Hamirpur Districts. To a lesser extent, damage by fire is also reported from the Bulandshahr, Jalaun and Naini Tal Districts.

VI—Agricultural stock.—Cattle diseases are reported from some of the districts, but the condition of Agricultural stock is, on the whole, satisfactory. The figures furnished by the Director of Veterinary Services, United Provinces, tabulated below when compared with those of the last month

indicate more seizures and deaths by foot and mouth diseases during the month under report. Seizures and deaths by haemorrhagic septicaemia and rinderpest are on the decline.

Disease	March, 1942		April, 1942	
	Affected	Death	Affected	Death
Rinderpest	1,001	706	8[illegible]8	562
Foot and mouth	1 670	13	6,137	26
Hæmorrhagic Septicæmia ..	281	258	122	117

VII—Pasturage and fodder.—No scarcity of either pasturage or fodder is reported from anywhere except in the Agra and Mainpuri districts.

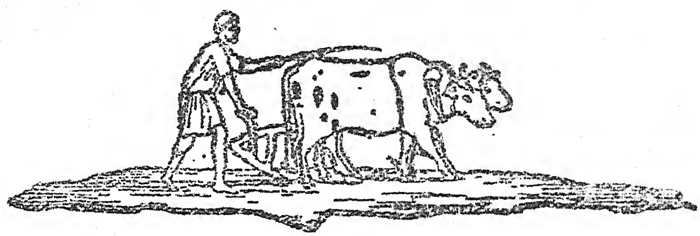
VIII—Trade and prices.—There has been no marked fluctuation in the prices of wheat, barley, gram and rice though a general downward trend is noticeable. The price of *arhar dal* have been more or less stationary with a slight rising tendency A comparative statement of the retail prices, in rupees per maund prevailing at the end of the last month and at the end of the month under report is given below :

	End of March, 1942	End of April, 1942
Wheat	5,392	5,311
Barley	3,503	3,262
Gram	4,246	4,011
Rice	7,320	7,235
Arhar Dal	5,356	5,522

IX—Health and labour in rural areas.—The condition of the rural population is generally satisfactory. Outbreaks of small-pox are reported from the Pilibhit, Ghazipur, Basti and Azamgarh Districts. Stray cases of plague and cholera have also been reported.

THE

ALLAHABAD FARMER



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Editorials

The January, 1942 issue was a general report of the various departments of the Institute. Because of the response to that one, the Institute authorities think it wise to make one issue each year the Annual Report Number. This is it.

In spite of very difficult financial stringency, the worst agricultural season in years, and the tense political atmosphere, the Institute has gone steadily ahead. Owing to all building material being commandeered by the authorities, the new Campbell Memorial Hostel is not quite complete, but everything essential is there. The girls are living in it and very happy to have this very beautiful addition to their facilities.

The B. Sc. Ag. Engineering course is open with a full quota of students. We consider this one of the most important enterprises the Institute has ever undertaken. It is of superlative importance to India.

The Government has put on a "grow more food" campaign and God knows India needs more food. As far as it has gone, the monsoon is one of the best that I remember in the 38 years that I have observed the rains. My duty this year has caused me to travel a little. Never have I seen at this time of the year so much rice and fodder crops planted and so well grown and healthy looking. A good monsoon season not only means plenty of rice and fodder, but it is the very best preparation for the cold weather crops—wheat, barley, potatoes, linseed, gram, and vegetables of all kinds.

Because many commodities cannot now be imported, we wish we could produce more milk to turn into butter and cheese. We also wish we had more grapefruit and other fruits. Also there is great demand for good quality pork products. We desire facilities to start swine husbandry. This would cause employment for trained men, and food for those who care for it.

If there is anything that is not clear in the reports or any suggestions that our friends have to offer as how to improve them, we would be grateful if they would write to us. The Institute is glad to be able to serve India at this time of great need.—SAM HIGGINBOTTOM

Indian Dairy Diploma Examination Results:

Out of 22 who appeared this year in this examination, 15 passed and 7 failed. Those who passed are the following, arranged in the order of merit:—Sukumar De, Khazan Singh, Behere D. Datatray, Atar Singh, K. C. Banerjee, Kamakshyapada Chatterjee, Ravish C. Agarwal, Sushanta Dutt, Kanakendu Das Gupta, Aragula Sreenivasa Rao, Mallik Abdul Hashem, Shron Singh, Suchitra Kumar Nag, S. L. Som and A. W. Khan.

We congratulate the above on their success.

Potatoes are a source of vitamin C, providing one-sixth to one-fourth of a soldier's daily quota of this vitamin.—*Science News Letter.*

REPORT OF THE AGRONOMY DEPARTMENT
1941-42.

BY

B. M. PUGH, S. R. MISRA, & S. C. BHATNAGAR.

Staff of the Department :—B. M. Pugh, B. Sc. (Calc.) B. Sc. Agri. (Calif , U. S. A.), B. D. (U. S. A.) Head of the Department.

G. Q. Vachoo, Marketing.

S. R. Misra, B.A., Dip. Agri., Farm Accounting.

E. J. W. Moraes, B. Sc. Ag. (Alld.), Assistant Instructor.

S. C. Bhatnagar, B. Sc. (Alld.), Assistant for field experimentation.

H. M. Browne, Time-keeper.

B. H. Pawar, Field assistant.

Mr. Moraes has to leave us at the end of the year in order to study Agricultural Engineering, and Mr. S. R. Barooah, M. Sc. has been added this year to assist in the teaching in the department. Mr. C. R. Horton of the Pyinmana Agricultural School in Burma worked temporarily in the department for a period of about one month and a half, and later had to leave us for America with his family. Mr. Bhatnagar has also joined the new Agricultural Engineering course, but is being continued part time in the department.

The activities of the department may be grouped under the following heads : (*a*) teaching, (*b*) demonstration, (*c*) research and experimentation.

Teaching :—B. M. Pugh and E. J. W. Moraes were the only full time teachers in the department. Mr. S. R. Misra also assisted in the teaching during the year.

Demonstration:—The report of the farm was first published in the last January issue of the Allahabad Farmer. This is now in the nature of an annual report of the farm for the last agricultural year, that is, June, 1941 to May, 1942.

The Weather:—It was an unfavourable year, resulting in reduced production of food, both for man and animals. The total rainfall in the year was below normal by 8" and its distribution was still more unsatisfactory. The monsoon started as early as the 3rd of June and light showers at irregular intervals continued till the middle of the month. The farm land was already ploughed during the summer and most of the *kharif* area was sown. Then followed a long break until the 3rd of July. The latter halves of July and August also had very deficient rainfall. Both the series of *kharif* crops sown in the first half of June as on the Institute farm, and in the first half of July as in the neighbouring villages, suffered a bad setback. Plenty of moisture, high humidity and intermittent sunshine are the most favourable conditions for the *kharif*, specially fodder, crops, resulting in their quick growth. This condition was seriously disturbed this year and led to the verge of a fodder famine in this area. The rainfall in June, July and August was hardly half of the normal in those months.

September rains are important, not so much for their direct effect on either *kharif* or *rabi* crops as for their indirect effect on them The last and the heaviest rain of the monsoon fell on the 19th of September. It resulted in a good deal of soil erosion and in the cutting of *bunds*, terraces and flumes at places. The rain in this month was above normal and a great deal of it was unnecessary agriculturally.

However, the September rains did facilitate the seed bed preparation for the *rabi* and seemed to offer a good prospect for the *rabi* for a time. But later on, this hope was turned into despair, especially for the unirrigated area, as from the 20th of September through December it was entirely rainless.

The so-called 'Christmas' rains came much later, in the third week of January and were not only far more than necessary but were also attended by hail. The farm

luckily escaped the full blow of the hail, but the crops in some of the villages in the neighbourhood were ruined. The weather did not stop at this even; it completed its vagary by a 4·30 inch rain in the third week of February. In many fields water was knee-deep.

Irrigation:—The unsatisfactory conditions, as stated above, were aggravated by the unsatisfactory supply of irrigation water. The vagaries of the seasons and the defects of the municipal sewage irrigation system, both combined, gave an unprecedented below to the farm production this year. Sewage water was stopped for three long periods this year—August 12 to September 16, October 16 to 31, and February 21 to March 7. In addition to this, when water did run during the year, the supply was very poor. From September to March the average daily supply worked out at only 1½ lac gallons, when the minimum guaranteed daily supply was 2 lacs. The irrigated area is only one-fifth of the total cultivated area of the farm.

Crop yields :—As a result of these facts, crop yields, in many cases, have been reduced this year. The *rabi* crop yield was only 47 per cent of the last three years' average yield. Potatoes and other vegetables were about 70 per cent of the average. The yield of Fodder was saved from going so low as will be explained later. The loss may not show up in money income, as the prices were higher. But the average yields would have given much more income at the current prices, which was necessary to obtain, in order to meet the present higher wages and the costliness of other factors of production. While we tried to carry out the 'grow more food' campaign, nature seemed to go against it.

Land Improvement:—No new terracing project was undertaken this year, terraces cut by rain were repaired. Two *bunds* were widened into roads to facilitate bullock-cart haulage. Parts of two fields were levelled thus bringing about 6 acres into proper shape for cultivation.

Manure:—Manuring of fields with compost is the regular feature. But much more fresh manure was applied

this year directly to fields than ever before. A considerable quantity was trenched also. In addition 400 maunds of oil cake were bought, which are used mostly for vegetable crops. About 50 acres were green-manured with *sanai.*

Field Practices:—Eleven new pairs of oxen were purchased from Fatehpur Half of this number was to replace old ones. Greater use of bullock-drawn implements was in evidence. The movement of labour to war industries has led to a rather serious shortage of labour available for agriculture. This shortage of labour, already felt or impending, can be offset, to an appreciable extent, by the increased use of animal power in farming. The greater use of bullocks depends on the greater use of implements other than the *desi* plough.

This year's capricious monsoon bore out the effectiveness of dry weather ploughing more clearly than ever before. The moisture-absorbing and moisture-retaining capacity of the ploughed fields was demonstrated this year beyond all doubt. This was the factor primarily responsible for keeping up the yields of fodder this year almost to normal.

This was the first year in which about 50 acres of unirrigated juar were sown with seed drills in rows 30 inches apart. The crop was inter-cultivated and earthed up twice with bullock-cultivators. The crop was harvested in November and December for seed. The yield of juar seed worked out to about 10 maunds an acre and that of stover to about 200 maunds an acre. These yields are at least twice the normal. Undoubtedly a large share of this encouraging result is attributable to better spacing of plants and inter-cultivating which was made possible by their being sown in lines. *Arhar* was not sown in this area as a mixed crop, except on 10 acres, and there it proved to be a poor crop.

Research and Experimentation:—The most outstanding work of the department in this section is the publication of a report of "Farm Cost Accounts in the Allahabad Agricultural Institute," by Mr. S. R. Misra. The report was published in two instalments in the March and May issues of the Allahabad Farmer. Arrangements are being made to have the report published in one volume,

so that it can be made available to others who may not be subscribers to the Allahabad Farmer.

Another outstanding accomplishment during the course of the year was the work done by Mr. Horton. During his very short stay here in Allahabad Mr. Horton made a detailed soil survey and prepared a soil map with the assistance of Mr. Bhatnagar, of the unirrigated section of the farm, an area of about 300 acres. Most of this area will soon come under tube well irrigation. Mr. Horton has thus left us a valuable record of the methods used in soil surveys in the United States of America.

The Agronomy Department with the help of the students who specialized in Agronomy continued to carry on several field experiments Reports of some of these experiments have already been published from time to time in "The Allahabad Farmer." The report of the experiments on wheat appeared in the March issue of "The Farmer," and the report on other experiments are now being written and will be published soon.

The field experimentation of the Agronomy Department consists mostly of what are known as "bulk" trials, and "small growths" trials. And in order that the students may get acquainted with as many crops as possible, we have to deal with a very large number of crops, which makes the detailed study of any one crop an impossibility.

Rice:—In the year under report we had altogether 25 varieties, 14 of which were local selections and 11 were the varieties of the United Provinces Department of Agriculture, T. 23, T. 32, T. 471/11, C. H. 10, T. 12, T. 66, T. 21, T. 36, T. 136, T 1, Paddy No. 1, T. 6, and Paddy (early). Of the Government varieties T. 471/11, C. H. 10, T. 36, T. 136, T. 1, and T. 6 seemed to be promising. T. 136 and many of the local selections, however, were very badly infected by a disease known as Piricularia (so identified by Dr. Vestal). The promising varieties are being continued again this year.

Cotton:—In 1941-42 only four varieties were grown for bulk trial. These are Perso-American, C. 520, C. 402,

and Mollisoni 39. The trials were made for unirrigated conditions. As the weather this year was very unfavourable for cotton the yields were very poor and there was no significant difference between their yields. The experiment is being continued again this year.

Juar :—In the year under report we had a bulk trial of six varieties of this crop. The varieties were 8B, T.9, 5 Tall, Malwa Selection, Do-dana white and Do-dana yellow. The first three are varieties recommended by the United Provinces Department of Agriculture; Malwa Selection is a strain of Malwa juars brought by B. M. Pugh from Malwa, and the last two are local selections. Of these six, 8B gave this year the highest yield of grain followed by Malwa Selection, Do-dana white, then Do-dana yellow, T.9 and 5 Tall, all in the order of merit. However the yield data as well as other data, such as data of germination and the "stand" are being analysed statistically in order to find out the best variety for the year. These data with the data collected in previous years will be published in a separate paper on juar later. Mass selection was also made in these six varieties and the seeds are being used this year again for a bulk trial.

Arhar :—Four varieties of arhar were grown for bulk trial. The varieties were T.51, T.80, local and Rammonia. The last two are local selections. There was no significant difference in the yield of these varieties.

Bajra :—Three varieties were tried out this year. T.11 and T.16 (the Cawnpore varieties) and a local selection. Bajra did not have a fair trial this year, as the bajra plot was isolated, that is far from any other bajra plot, and therefore was subject to a very heavy attack of birds. The yield of grain showed no significant difference although the local seemed to yield more fodder than the other two.

Gram:—Three varieties of gram were grown for bulk trial, T. 17, T. 28 and a local variety. The data showed no significant difference in yield, although T. 17 possesses better grain and is more uniform in appearance. Both T. 17 and T. 28 are Imperial Pusa varieties.

Barley :—The following seven varieties of barley were grown in replicated randomized blocks:—H. 1-92, C. 251, T. 24, Local, T. 20, 300 A and I.P. 21. Of these C. 251 gave the highest yield of grain but was not significantly different from 300A or T. 20. These were followed by I. P. 21, Local, H. 1-92 and T. 24. This last was very poor. Of the varieties under trial the rust incidence of the Local variety was the worst. H. 1—29 and 300A were also very badly affected by rust. C. 251, T. 20, I. P. 21, and T. 24 showed some degree of resistance to some kinds of rust.

Linseed :—Four varieties of linseed were under trial. These were T. 1193, T. 1150, Nagpuri (A variety brought from Nagpur by Mr. K. K. Misra) and Local. There was no significant difference this year on the yield of seed. Of these four, Nagpuri is a bold type of linseed, the gramme count for Nagpuri being 105 to 108. The gramme counts for the other varieties were as follows: T. 1193, 120 to 125; T. 1150, 121 to 126; and Local, 118 to 123.

Wheat :—During the year under report eight varieties of wheat were grown for bulk trial. These were I.P. 165, I.P. 111, I P. 4, I.P. 54, I.P. 52, C. 13/A, C. 13/C, and Local. The planting was very much delayed so that the results may not be considered as reliable as in other years (*see the report on the wheat experiments in the March*, 1942, *issue of the Allahabad Farmer*). However, the data for yield, lodging and rust resistance were again recorded this year, and we report on these for what the reports are worth. A little explanation about C. 13/A and C. 13/C is perhaps necessary. C. 13 is a selection of Mr. Rama Prasada, Economic Botanist, U.P. Government. Mr. Bhatnagar, believing that there might have been deterioration in the C. 13 which we have at the Institute suggested that we get fresh seeds of C. 13 from Cawnpore. This was done. So the two lots of C. 13 were named C. 13/A and C. 13/C respectively. Results later seem to bear out the contention of Mr. Bhatnagar, but this will be tested again this next year.

The results of the grain yields in the bulk trial during the year under report were as follows:—C. 13/C—67·85,

I.P. 165—54·85, I.P. 54—50·85, I.P. 52—47·80, I.P. 111—42·90, C. 13/A—39·20, I.P. 4—38·55, and Local 22·00. In resistance to lodging the scores were I. P. 165—32, I. P. 111—28, I.P. 4—27, C. 13/A—21 I.P. 54—20, I. P. 52—19, C. 13/C—16, and Local—10. In rust resistance I P. 165 again came first followed by C. 13/C, C. 13/A, I.P. 111, I.P. 4 which appear to be in the same class and were followed by I.P. 54 and I.P. 52, which also seem to belong to a class by themselves, and these were followed by the Local which appears to be the worst. The yield of *bhusa* of the different varieties were C. 13/C—225, I.P. 54—177, I.P. 165—166, I.P. 52—157, C. 13/A—141, Local—122, I.P. 111—121, and I.P. 4—116.

Oats :—Six varieties of oats were under trial. These were C I. 2820, C.I. 2054, Local, Mulga, Westene and C.I. 3253. The C.I. varieties were from the "Crop investigations" department in U.S.A., Mulga and Westene are varieties from Indore. In fodder yields the records were as follows:—C.I. 2820—440, C.I. 2054—437, Local—422, Mulga—391, Westene—375 and C.I. 3253—313. The grain yields data were as follows: Local—123·40, C.I. 3253—122·95, Mulga—118·85, C.I. 2820—108·15, C.I. 2054—97·05, and Westene—84·50.

Small Growths Trials:—The department has also a plot in which varieties of crops received for the first time or which are not yet ready for bulk trials are grown for seed multiplication, or/and for preliminary observation, or/and for acclimatisation.

In this plot we had four types of *rai* (mustard):—R.T. 2, R.T. 3, R.T. 9, and one type of local *sarson* (also a mustard) and one type of *toria* (rape).

We also had six varieties of gram: —I.P. 53, I.P. 25, I.P. 58, T. 28, T. 12 and a local variety. Of these I.P. 53 seems to have done the best in these small growths trials.

Then we had three varieties of the Imperial Pusa (I.P.) oats, and eight American varieties. Of the first group, I.P. 2 seemed to be very promising. I.P. 1 also did well but the performance of I.P. Hybrid 1 was disappointing. Of the eight American varieties, Oats Selection 1297, Oats Victor Grain C.I. 3693, Oats Selection 1027, and C.I. 3730

have been selected for further trials. Others were discarded as they were too late to mature.

In the linseed there were nine varieties:—I.P. 55, I.P. 68, I.P. 12, I.P. 14, I.P. 21, I.P. 10 and Local 1, Local 2, and Local 3. I.P. 68 appeared to be very promising, but all are being retained for further trial this year.

In the plot we also grew one I.P. 13 safflower, a fodder variety which is spineless, and also I.P. 29 pea. Then we started this year a zone trial of nine varieties of sugar cane which we received from Shahjahanpur. These are Cos. 146, Co. 313, Co. 527, Co. 393, Cos. 5, Cos. 76, Co. 331, Co. 421, Co. 312. Reports of the behaviour and performance of these canes will be made later.

We also started propagating three sugar-cane sorghum crosses which we received from R. Thomas, Esq., C.I.E., of Mirpurkhas, Sind. The varieties are Co. 559, Co. 560, and Co. 561. These are at present doing well, but their values as fodder, for which they are intended, have not as yet been determined.

A Manurial Experiment:—The department was also carrying on this year an experiment with trenched manure. The experiment was started in 1939, and report of this experiment will be made later.

Plant Breeding:—Another type of work that was done in the *kharif* season this year was the survey of the *juar*, *bajra*, *mung* and *urd* crops of a locality about 16 square miles in area. As the result of this survey six new selections of *juar* were made, five of *bajra*, two of *mung* and two of *urd*.

In the *rabi* season a cross was made between I.P. 165 wheat and C. 13. Out of this cross 100 seeds were collected. Selections were also made on I.P. 4 for next year's progeny rows. In I.P. 54 certain plants were noticed to have red glumes These were also collected for further study. We also made selections on the local wheats for next season's growth.

Selections were also made in oats, gram, and mustard. Seeds from a single plant of linseed which was characteristic of flax were also collected for further study.

REPORT OF THE HOME-MAKING DEPARTMENT, 1941-42

By

DR. ETHEL CODY HIGGINBOTTOM

The new Campbell Memorial hostel is now occupied by 15 girls. It was not ready for use on July 6th because building material had been commandeered for military work. Also carpenters were difficult to get so we do not yet have all the furniture which we need. Even so our new building with its big airy living rooms is a great pleasure to us all. Lady Hallett who laid the corner-stone of this new hostel was happy at a recent visit to see the nearly completed building occupied by the girls. Both she and H. E. The Governor remarked on the fine structure and attractiveness as well as the utility of the building as a whole. Mr. Campbell and his children recently added to their original gift a sum which cares for the extra building cost and lets us furnish the building more comfortably.

Because of the difficulty in getting back and forth to classes in the engineering building and because Science building class-rooms are in greater demand this year, the living rooms of the west practice house are in use as class-rooms. This means that only one practice house is used as such. First year girls live in the second practice house but the kitchen is used for the foods laboratory, the living room is a class room and one bed room is the handicrafts room. This means all our equipment is at hand and ready to be moved into a class-room building when we get it. We hope that it will come soon so that we can fill the west house with girls next year.

We had between 30 to 40 applications from girls who wanted to enter but as we had only four small Government stipends to offer, and there are other E. T. C. training schools which could offer bigger and more stipends, some of the girls who had to have help have gone to these other institutions. However gifts from friends have made it

possible to help a few girls from needy homes. Our first year class now consists of 14 splendid young women. All the seven girls of the 2nd year class have also returned and are hard at work in their E. T. C. preparation. There are two special students and more may come.

Mrs. Azariah having acquired a little son has not yet returned but we hope to have a nursery school when she is back with us. Mrs. Warner who now has a healthy little daughter of 7 months has begun work again teaching nutrition. Mrs. Vaugh is undertaking to help with our handicrafts since, we are sorry to say, Mrs. Pugh has been ill. Mrs. Pugh is making slow progress and we hope later on will be able to teach. Meanwhile Mrs. Koshy, one of our own graduates and wife of a staff member and warden, has returned from her home in Travancore with her 3 months' old baby and is doing her share in teaching handicrafts. Of course without Miss Hoffman we could not carry on as she teaches chemistry of foods, cooking, sewing, meal planning, the supervision and care of the hostel and the home practice unit; besides Miss Hoffman and Mrs. Joshi care for the sports. All the men on the staff are helpful but Mr. Vaugh with the building, Mr. Hayes with the admissions and other work, Mr. Wesley teaching Nature Study and General Science and Mr. Chand teaching gardening and planning our flower gardens make it possible to keep our department going. All the staff members have been splendid in helping with the chaperoning. Miss Ellen Singh is again hard at work inspiring girls to take seriously class room management, and practice teaching. She is eating at the teachers' table in the new dining room with Miss Hoffman, Miss Das the matron, and Miss Hilda Singh, a former student, now an assistant staff member. Dr. Hayes not only teaches hygiene but has examined all the girls and cared for the sick. Unfortunately one girl came with fever which proved to be typhoid. Her mother came to help in her care and will soon be able to take her daughter home. Most of us staff members need Dr. Hayes in order to keep fit for our job.

Various parties given by students and staff members cheer the young people during week-ends. Church across

(*Continued on page* 338.)

REPORT OF THE DEPARTMENT OF AGRICULTURAL ENGINEERING, 1941-42.

By

MASON VAUGH

The outstanding event of interest along agricultural engineering lines during this year has been the completion of arrangements for the institution of the degree course in agricultural engineering at the Institute, in co-operation with the Allahabad University. As is the case in the courses in other branches of agriculture, leading to the B. Sc. (Agr.) degree, students with the minimum qualifications of Intermediate diploma in agriculture, are admitted by the University on the recommendation of the Institute. All teaching is done at the Institute and the final examination is set by and the degree awarded to successful candidates by the University. The tentative arrangements, reported last year, were completed late in the academic year and as this report goes to Press students are actually in attendance.

This event is of some historic importance because it marks the first time that training of a professional nature in the application of engineering to agriculture has been offered in Southern Asia. The Industrial Revolution in Western countries began to make modern materials and mechanical power available for the use of agriculturists late in the 18th century. The fourth decade of the 19th century saw the beginning of the revolution in western agriculture in the perfecting and marketing of the reaper for harvesting grain crops. Early inventions of new implements was carried out by farmers, local blacksmiths and other "laymen". Their development and manufacture was carried on by men trained in agriculture and in the older branches of engineering. It was not till the beginning of the second decade of the 20th century, about 30 years ago, that the training on a professional basis of men in the application of engineering knowledge to agriculture was begun. Such training has been

widely developed in the United States and Canada, where some 30 colleges now give such professional training. England has so far developed it only in one school where graduate training is available. India is thus still among the pioneers in this development.

At the time of writing, registration of students is not complete but it is expected that the full class of 12 men will be admitted. The number of applications has been more than that of the seats available, indicating a widespread interest in the subject. Non-professional training in some agricultural engineering subjects has been included for a long time in the curriculum of the agricultural colleges in India which has served to some extent to acquaint people with the possibilities of the development of Indian agriculture by the sound application of engineering principles along with the other branches of knowledge.

Most of the changes in staff occurring in the year were reported in the previous report which covered part of the year now under report. Having a fully trained agricultural engineer, Mr. M. D. Strong, on the staff has greatly strengthened the teaching work. The transfer of Mr. M. K. Nandy to the duties of Mr. J. C. Barpujari on his resignation to accept a job in the Assam Department of Agriculture, left no one to carry on the work for which Mr. Nandy had been appointed. At the end of March, Mr. Thoomickian left the post of salesman to seek other work. Mr. P. K. Bhargava, B. Sc. (Agr. 1942) was appointed salesman from May 1st. Due to delay in appointing new staff for the engineering course, it has been necessary to use Mr. Bhargava temporarily for teaching work but it is expected that he will revert to his regular post about the time this appears in print. Mr. Nandy has been given leave to take the degree in agricultural engineering and is for the next two years to be a student. He will give part-time assistance in the work of the department during this time.

Research and development work has rather lagged during the year under report, partly because of lack of staff capable of doing the work, partly because of the generally unsettled conditions due to the war and partly due to

a pause to digest previous progress. It is being increasingly recognised that the development of new implements alone is not sufficient. Equally or possibly more important is the development of suitable procedures and techniques to go with them. New implements make possible operations not previously possible. The effectiveness of the new implements and consequently their ultimate popularity depends on the exploitation of these new techniques in the operations made possible by the improvement in the implements. Considerable time has been devoted to a study of the procedures to be followed in various field operations and some field tests have been initiated. It is felt that it is important that we develope implements and technique simultaneously, modifying each in the light of the other. Indian climatic conditions differ radically from those of the western agricultural countries, where the use of improved implements is most widespread. This difference is reflected in soil conditions, in desired operations and in crops grown. It seems definitely certain that we will not get best results by the adoption of techniques and procedures developed in the western countries any more than we would by the wholesale adoption of western implements. This study has occupied most of the time available for research and development. Some time has continued to be given to problems previously mentioned as being under development.

The manufacture and sale of implements has continued about as before during this year. Full development of sales was hampered by the uncertainty as to whether material would be available for manufacture or not. This uncertainty led to caution about pushing sales. Material purchased was subject to great delay in arriving and especially toward the end of the year, considerable and increasing delay occurred in booking implements being despatched. In view of this uncertainty, sales for the year were highly satisfactory. The following table shows the number of implements sold and the prices realised.

			Rs.	a.	p.
Shabash ploughs	...	1,131	6,338	12	0
Shabash cultivators	..	11	146	0	0
Wah Wah Plough sets	...	51	1,431	10	0
U. P. ploughs	...	12	342	4	0

			Rs.	a.	p.
Wah Wah seeding machine		1	125	0	0
Butter churns	...	2	150	0	0
Butter workers	..	1	45	0	0
Spare shares	...	400	353	2	3
Hand hoes and rakes	...	25	20	10	0
Earth scoops	...	3	135	0	0
Loppers and hedge shears	...	6	27	8	0
Latrine borers	...	17	840	0	0
Butter paddles, etc. pc.	...	16	12	0	0
		Total	9,977	7	3

The above list of sales include only items sold to those outside the Institute. It does not include any items used in our own work or our manufacture. Some orders had to be refused due to lack of material at the time of the order. The resignation of Mr. Thoomickian as salesman reduced the amount of touring which could be done and doubtless reduced sales somewhat. Conditions of railway travel is likely to hamper touring of the salesman this next year also.

The work of maintenance of our plant and the erection of new buildings has continued about as usual. During the latter part of the year, the new building for the Home-Making Department was under construction and before this is in print the building will be fully occupied though some items such as the parapet around the roof and the upstairs verandah railings have had to be left undone because of lack of material. Early in the year, a new transformer was installed in our power sub-station, bringing into effect a new contract with the Electric Supply Co. by which we get more favourable rates than before. The wiring of the sub station was redone and the switch-boards were re arranged. The power line has been extended to the new tube-well and at the time of writing, the work of construction and installation is going on at the tube-well, preparatory to bringing it into use for the next cold weather crop.

While the war is causing increasing difficulty in getting supplies and our old stocks are slowly being depleted, we have been fortunate in that we have been able to get all essential commodities up to our minimum necessities. There is now doubt whether we can maintain this fortunate position in the future but we are thankful that it has been possible up to now.

REPORT OF THE DEPARTMENT OF HORTICULTURE, 1941-42

BY

W. B. HAYES

The disease which had appeared on certain citrus trees a few weeks before the last report was written soon ceased to spread, and in the early spring new growth appeared on the infected branches. Later the dead twigs were removed, and there has been no further evidence of the disease, the cause of which remained unknown. At present the trees appear normal, but a watch will be kept for symptoms during the coming winter.

The summer was unusually hard on trees, and a number of grapefruit trees which had been weakened by gummosis died, as well as a few young trees which had not become well established. The seedling grapefruit trees have now been planted in the orchard for 10 years, and although they are planted 25 feet apart and are tall, some of them are beginning to touch each other. Many of them are bearing a satisfactory crop, but some have not yet borne.

Records of the estimated number and weight of guavas from heavily and lightly pruned trees in the last season are similar to those in previous years. The fruits on the heavily pruned trees were nearly twice the size of those on the lightly pruned trees, but there were so few of them that lightly pruned trees planted 25 feet apart produced about twice as much fruit per acre as the heavily pruned trees at 15 feet. A few lightly pruned trees at 15 feet produced about 7% more per acre than those at 25 feet, but they are crowded so that cultivation by animals is impossible, and the yield cannot be expected to increase, while the trees which are 25 feet apart should continue to grow and to produce increasingly heavy crops for several years. Thinning was practised on six of the trees planted 25 feet apart, selected at random. From one-third to two-thirds of the fruits were removed

while quite small. It happened that even with this thinning, more fruits remained on the trees than the average for the block. The size of the fruits was increased about 50% over the unthinned trees.

No conclusive results were obtained by spraying sweet orange trees with salts of zinc or iron. Considerable mottle-leaf is still evident, and experiments are being continued.

Experimental work on fruit products has been continued. After trying several recipes, squash was successfully prepared from the Rangpur lime, hill lemon and *athani*. Lime and lemon cordial with an attractive colour was also made. A recipe for guava cheese which seems satisfactory has been worked out, and cheese made by it was kept in good condition for eight months in an ordinary glass jar. Further improvement has been made in mango squash, and this has proved very successful as a flavouring for ice cream made by the Institute Dairy. It imparts a pleasing colour as well as a delicious flavour to the product. Mango pulp and peas have been successfully canned.

During the summer vacation I visited a place in the Kumaun hills, not far from the Nepal border, where I had heard there were wild lemons. There proved to be two types. One, called *jamir*, seems to be the rough lemon, or something very similar. The other, which was called *agnia*, was different from anything I had previously seen or heard of. The fruit is flattened globular, said to be yellow when ripe, and very sour. A typical leaf was about nine inches long, and more than half of it was the winged petiole. Small plants of both types were brought to Allahabad.

A factory in Brazil will turn oranges into concentrated juice, cattle fodder, and paper pulp.—*Science News Letter.*

German chemists have evolved a rice-like new food, mainly made of potatoes and whey.—*Science News Letter.*

REPORT OF THE DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING, 1941-42.

By

JAMES N. WARNER

This report covers the period corresponding to the financial year of the Institute, that is April, 1941 to March, 1942, inclusive. The first report of this series, published in January of this year, was an attempt to set forth an approximation of the scale and scope of the activities of this Department. It is not intended that all reports shall follow the form already established, but the form of tables will be changed as little as possible from time to time to avoid the confusion that arises whenever it is necessary for the reader to transcribe data in one form to data in another in order to compare the same tables in different reports.

TABLE I

Sales of Milk and Milk Products from April, 1941 *to March,* 1942

(FIGURES IN POUNDS AND OUNCES)

	Milk	Butter	Dahi	Cream Cheese	Cream	Ghi	Ice Cream	Cheddar Cheese	Daily average for milk
April ..	26,131-8	1,401-6	1,988-8	75-12	33-2	5-7	308-8	..	871-8
May ..	20,720-8	1,057-4	885-0	26-13	12-2	..	242-0	..	668-6
June ..	18,361-0	1,125-13	609-0	65-4	8-12	10-0	125-8	..	612-5
July ..	23,895-0	1,548-7	996-0	40-0	21-4	..	42-0	..	770-13
August ..	30,467-0	1,584-0	1,425-0	11-14	18-0	..	167-0	..	982-13
September	29,008-8	1,463-11	1,290-0	25-0	18-10	..	114-0	..	966-15
October ..	30,806-8	1,725-0	1,288-8	59-0	19-4	..	104-0	..	933-11
November	27,153-0	1,959-7	963-8	93-12	27-4	..	166-0	..	905-1
December	21,037-0	2,300-10	834-0	101-6	41-10	1-8	..	..	678-9
January ..	17,017-8	2,914-15	730-0	84-4	29-6	40-7	..	13-8	548-15
February	16,503-0	1,908-1	864-8	75-4	39-11	25-10	55-0	19-14	589-5
March ..	19,370-8	2,083-9	2,093-8	83-12	39-0	3-14	416-8	147-2	625-0
Total ..	280,471-0	21,072-3	13,967-8	742-1	308-1	86-14	1,740-8	180-8	768-6

Milk and Milk Products :—The sales of milk and milk products during the year are given in Table I. Sales by months are indicated to show the variations from month to month for each product.

Daily milk sales were highest in October and lowest in January. The difference in the daily averages of the two months was 444 pounds 12 ounces or approximately 82% of the January sales. Normally the lowest sales occur in May and June. This year, however, the increase in the retail price of milk was largely the cause of a decrease of monthly sales of 4000 pounds during that month as compared with December. Furthermore, the demand for fluid milk in Allahabad during the hct months, when schools are closed and large numbers of people are on holiday elsewhere, was unusually high this year as a result of many semi-permanent visitors in the city. The total of 280,471 pounds sold during the year is the highest yet for this Department.

Butter sales varied from 1057 pounds in May to 2915 pounds in January. The minimum demand for butter normally occurs in May, or possibly June. This demand usually increases rather rapidly until the month of September or October. This condition, although common, has not manifest itself in sales increases for several years, especially this one

Village cattle and buffaloes are allowed to breed at will. This results in a majority of these animals freshening within a period of two months or so. It is, therefore, immediately after a calving season that villages supply the maximum amounts of milk or cream. This season of high supply, unfortunately, does not correspond with the highest demand for butter.

As the butter demand increases after July it has been found impossible to obtain the necessary cream. The figures for butter sales, although they show an increase from June through August, indicate not the total demand for butter which could have been met, but rather that portion of an increasing demand which it was found possible to meet under the conditions indicated. A cream supply that would rise and fall with the butter demand is obviously the ideal.

Supervised control of the calving season in our surrounding villages, it appears, is indicated.

Dahi is a hot weather product, that is its demand varies with the seasons, as indicated by the sudden rise in sales from 864 pounds in February to 2093 pounds in March. Sales of dahi are low in May, June and July also because of the movement of many of the customers of our dairy from Allahabad to their homes, in the case of students, or to holiday resorts. Dahi sales varied from 609 pounds in June to 2093 pounds in March, a variation of nearly 345% of the minimum.

Very small quantities of cream cheese and cream are sold. These are products for which there is very little demand in the home, especially in the case of cream cheese. The small quantities of cream that are used are more commonly obtained by partly skimming milk which is available than by direct purchase.

Ghi must sell at very high prices before it is economical under commercial conditions. Occasional small quantities are made by students of the Institute in their dairy practical work. There are also times when a small accumulated stock of butter may be converted into ghi in order to dispose of it. Otherwise ghi is not made by this Department.

The average ice cream order was for 18·3 pounds. During the year over 1700 pounds were sold, principally in the months of March, April and May. Ice cream, as has been stated in reference to dahi, is another seasonal product. Sales during two and one-half months in the winter were nil, whereas 416 pounds 8 ounces were sold in March alone. June and July sales were small principally because of the absence of customers, especially in June. Sales in October and November held up to those during the hot months of the monsoon because this product sold in fair quantities daily at the All India Swadeshi Exhibition where the Department maintained a stall.

Four flavours have been offered, *viz.* vanilla, chocolate, mango and gur-nut. Mango is made by the use of a mango squash prepared in the Horticulture Department and which has proved to be a very fine quality product

for the purpose. The quality of the gur alone has limited the sales of the gur-nut. Vanilla sales, as is true in most countries of the world, surpasses any other.

Cheddar type cheese of a fair quality can be made domestically if two fundamental conditions are met: the supply of milk must be of an unusual high quality and refrigeration must be available for curing. This Department has no difficulty producing its own milk of the quality required for good cheese. It was, however, only after a small refrigeration plant was reconditioned for operating a cold room, constructed three years ago, at the required temperatures, that we could attempt to produce small amounts of cheese commercially. Again students have always made some for practice, but without proper curing facilities it was not extended beyond the purpose it served students.

About 180 pounds of this cheese were sold in the last three months of this year. This is, however, only the beginning of a programme of converting most surplus milk, during the season of low milk sales, into cheese. In this case also the figures represent the quantity it was possible to make, not the total demand, as it was too great to meet under the circumstances, despite the fact that the manufacture of this product has just started. Much greater sales during the next year are certain.

All India Students' Cattle Judging Contest

The second All India Students' Cattle Judging Contest was held at the Fifth All India Cattle Show at Delhi in February. Seven teams competed this year as compared to nine the year before. The first prize this year was won by the team representing this Institute Students comprising the team were 1. Mr. A. S. Verma (Captain), 2. Mr. K. Khazan Singh, 3. Mr. Shron Singh, 4. Mr. K. Das Gupta and 5. Mr. S. K. Nag.

Scoring this year was based on the placing of the animals, oral reasons and written reasons for the placing. The team tied for second in placing the animals, tied for third in oral reasons for the placing and was second in written reasons.

Milking Stock

The strength of the Institute milking herd during the financial year of 1941-42, ending on 31st March, 1942, was as follows :—

TABLE II

	Number on 1-4-'41	Transferred from female young stock	Sold	Died	Number on 31-3-'42
Red Sindhi	35	5	3	1	36
Jersey-Sindhi ..	24	2	1	..	25
Brownswiss-Sindhi / Brownswiss-Harriana ..	8	..	..	..	8
¼ Jersey-Sindhi ..	9	8	1	..	16
¼ Brownswiss-Sindhi / ¼ Brownswiss-Harriana	14	5	1	..	18
¼ Holstein-Sindhi ..	7	..	1	..	6
1/8 Jersey-Sindhi .	..	2	..	..	2
1/8 Brownswiss-Sindhi ..	..	1	..	..	1
1/8 Holstein-Sindhi .	..	1	..	..	1
Miscellaneous cows .	24	5	4	4	21
Murrah buffalo ..	28	12	1	2	37
Totals ..	149	41	12	7	171

Our breeding policy has remained the same as was outlined in last year's report.

During the annual Farmers' Fair a good number of grade Murrah buffaloes was entered by the villagers. It was encouraging also to see a large number of entries of cows as compared to the previous year. The village gowallas' milking competition and village gowallas' judging contest attracted

considerable attention of the villagers. One noteworthy feature was that in both of these competitions younger men excelled their elders.

The following statement shows the performance of those animals which completed their lactations during the year.

TABLE III

	No. of Lactations completed during the year 1941-'42.	Average yield in lbs.	Average days in milk.	Average days dry preceding the lactation.	Milking average per day during milking period.	Over all average.
					lbs.	lbs.
Red Sindhi ..	23	3463·3	308·4	101·3	11·2	8·4
Jersey-Sindhi ..	20	4388·0	320·4	67·4	13·7	11·3
Brownswiss-Sindhi, Brownswiss-Harriana.	7	5072·0	377·5	72 1	13·4	11·2
½ Holstein-Sindhi	7	4557·3	284 0	93 0	16·0	12·0
½ Brownswiss-Sindhi	13	4242·5	324·6	85·2	13·0	10·3
½ Jersey-Sindhi ..	8	4237 8	323 2	81·7	13·1	10·4
Miscellaneous cows	18	3703·2	318·2	115 0	11 6	8·5
Murrah buffaloes ..	19	3658·4	312·4	140·7	11·7	8·0

During the year under report 4,66,692·3 lbs. of milk were produced. A detailed statement giving the performances of the different herds is given below.

TABLE IV

	April 1941	May 1941	June 1941	July 1941	August 1941
Sindhi lbs. ...	6854·8	6794·1	6112·7	6171·2	8146·6
Cows in milk ...	24	24	21	19	23
" dry ...	4	4	7	9	6
Overall daily aveg. lbs.	8·1	7·8	7·2	7·1	9·0
Jersey-Sindhi lbs. ...	7703·6	7633·9	5833·5	6917·6	8734·8
Cows in milk ...	23	21	15	19	23
" dry ...	1	3	9	5	1
Overall daily aveg. lbs.	10 7	10·2	8·1	9·2	11·7
Brownswiss-Sindhi " -Harriana	4066·3	4070·2	3684·5	3461·3	3286·1
Cows in milk ...	8	8	8	8	8
" dry ...	0	0	0	0	0
Overall daily aveg. lbs.	16·9	16·4	15·3	13·9	13·2
¼ Holstein-Sindhi lbs. ...	2487·0	1695·4	1459·1	2281·8	2599·3
Cows in milk ...	7	4	6	7	6
" dry ...	0	3	1	0	1
Overall daily aveg. lbs.	11·8	7·8	6·9	10·5	11·9
¼ Jersey-Sindhi lbs. ...	3075·8	3347·2	2588·7	2789·1	3849·0
Cows in milk ...	9	8	7	9	12
" dry ...	0	2	3	2	1
Overall daily aveg. lbs.	11·4	10·8	8·6	8·1	9·5
¼ Brownswiss-Sindhi " -Harriana	4706·7	5896·2	5426·7	5945·2	5462·4
Cows in milk ...	14	14	13	15	15
" dry ...	1	2	3	1	1
Overall daily aveg. lbs.	10·4	11·8	11·3	11·9	11·0
⅛ Jersey-Sindhi ...	...	...	...	...	...
⅛ Holstein-Sindhi ...	...	...	...	...	...
⅛ Brownswiss-Sindhi ...	...	...	...	...	...
Miscellaneous Cows lbs.	5807·5	5525·5	5336·2	5539·6	6027·5
Cows in milk ...	17	16	15	17	18
" dry ...	1	2	3	1	2
Overall daily aveg. lbs.	10·7	9·9	9·8	9·9	9·7
Total Cows lbs. ...	34,692·7	34,962·5	30,441·4	33,106·5	38,106·1
Cows in milk ...	102	95	85	94	105
" dry ...	7	16	26	18	12
Overall daily aveg. lbs.	10·6	10·1	9·1	9·5	10·5
Murrah buffaloes lbs. ...	4508·5	4323·3	3530 4	3631·9	7521·7
Buffaloes in milk ...	14	12	11	15	21
" dry ...	8	10	10	7	6
Overall daily aveg. lbs.	6·8	6·3	5·6	5·3	8·9

TABLE IV

Sept. 1941	October 1941	Nov. 1941	Dec. 1941	January 1942	February 1942	March 1942	Total production	Monthly Average No. of cows	Overall daily average
8405·0	8736·2	7815·4	5884·1	4997·4	4014·6	4295·6	78,218·7		
23	24	25	23	23	22	23	...		
6	5	4	6	6	7	7		28·75	
9·6	9·7	9·0	6·5	5·5	5·0	4·6			
							...	...	7·4 lbs.
8559·6	7920·0	7168·8	7201·0	8761·6	7930·0	8312·6	92,677·0		
20	21	20	22	22	23	23	...		
4	2	3	1	2	1	1		23·75	
11·8	11·1	10·3	10·1	11·7	11·8	11·1			
							...	...	10·6 lbs.
2991·4	1875·9	1568·0	1389·6	1382·4	1429·5	2136·2	31,341·4		
7	6	7	5	5	3	5	...		
1	2	1	3	3	5	3		8·00	
12·4	7·5	6·5	5·6	5·5	6·3	8·6			
							...	...	10·7 lbs.
1685·7	1394·1	1265·5	1916·8	2824·7	2831·6	2794·1	25,235·1		
6	3	4	4	5	6	6	...		
1	4	3	2	1	0	0		6·70	
8·0	6·3	6·0	10·3	15·1	16 9	15·0			
							...	...	10·5 lbs.
4317·2	4098·8	4070·7	3809·4	4428·5	3573·9	3577 4	43,526·4		
10	11	11	13	12	11	11	...		
3	2	2	1	2	3	5		12·50	
11·0	10·1	10·4	8·5	10·2	9·1	7·2			
							...	...	9·5 lbs.
5119·6	5430·5	3485·4	2420·5	3139·4	4394·6	5233·2	56,660·8		
18	18	17	12	12	14	15	...		
0	0	1	5	6	4	3		17·00	
9·5	9·7	6·4	4·6	5·6	8·7	9·3			
							...	...	9·1 lbs.
...	...	...	...	503·4 (1)*	768·0 (2	951·0 (2)			
...	...	...	...	366·5 (1)	307·9 (1	325·0 (1)	3232·5		
...	...	...	...	...	...	10·7 (1)			
4961·5	5268·3	3719·5	4210·3	5596·8	5192·7	4490·2	61,675·6		
17	17	15	14	19	17	17	...		
2	3	4	4	1	2	2		18·80	
8·7	8·5	6·5	7·5	9·0	9·7	7 6			
							...	...	9·0 lbs.
36,040·0	34,723·8	29,093·3	26,831·7	32,000·7	30,442·8	32,126·1	3,92,567·6		
101	100	99	93	100	99	104	...		
17	18	18	22	21	22	21		116·20	
10·1	9·5	8·2	7·5	8·5	8·9	8·2			
							...	...	9·2 lbs.
8538·2	9580·4	7598·6	7694·6	7063·6	5355·6	4777·9	74,124·7		
26	28	27	25	26	24	21	...		
3	[illegible]	2	4	3	5	10		25·90	
9·8	10[illegible]	9·8	8·5	7·8	6·6	4·9			
							...	...	7·8 lbs.

* Numbers of animal…

Female Young Stock

The following statement gives the number of female young stock in the herd during the year ending March 31st, 1942.

TABLE V

	Number on 1-4-'41	Born during the year.	Transferred to milch stock.	Sold	Died	Number on 31-3-'42
Red Sindhi ..	22	12	5	..	2	27
Jersey-Sindhi ..	3	..	2	1	..	..
¼ Jersey-Sindhi ..	28	18	8	.	4	34
¼ Brownswiss Sindhi / Brownswiss-Harriana	12	3	5	..	..	10
¼ Holstein-Sindhi ..	2	..	..	..	..	2
1/8 Jersey-Sindhi ..	5	8	2	1	3	7
1/8 Brownswiss-Sindhi	8	9	1	..	2	14
1/8 Holstein-Sindhi ..	10	6	1	..	2	13
1/16 Jersey-Sindhi ..	..	1	..	.	..	1
1/16 Brownswiss-Sindhi. ..	..	1	..		..	1
Miscellaneous cows ..	15	9	5		4	15
Murrah buffalo ..	31	15	12	..	7	27
Total ..	136	82	41	2	24	151

The average age, weight and height at withers at first calving of 41 heifers which, according to the above Table V, were transferred to milch stock during the year, is as follows :—

TABLE VI

Red Sindhi	3·04 Years.	698 0 lbs.	44·2 inches.
Jersey-Sindhi	2·64 ,,	756·5"	45·6 ,,
½ Jersey-Sindhi	2·33 ,,	648·0 lbs.	44 3 ,,
½ Brownswiss-Sindhi ..	2·49 ,,	712·0 ,,	46·2 ,,
1/8 Jersey-Sindhi ..	2·34 ,,	629·0 ,,	42·5 ,,
1/8 Brownswiss-Sindhi ..	2·20 ,,	595·0 ,,	44·7 ,,
1/8 Holstein-Sindhi ..	2·60 ,,	680·0 ,,	45·3 ,,
Miscellaneous cows ..	2·40 ,,	663·0 ,,	44·6 ,,
Murrah buffalo	3·50 ,,	1188·0 ,,	52·0 ,,

The general health of the female young stock was satisfactory. Data regarding the growth of young animals as indicated by live weights are being maintained. Heretofore our system of numbering the animals was by means of metal ear tags. During the year a tattooing set was purchased and we have started tattooing the animals.

During the year under report three Sindhi bulls were sold to Assam Government.—*N. R. Joshi.*

Artificial Insemination

A limited number of cattle and goats were impregnated with sperm collected by means of the artificial vagina. We have one Jersey-Sindhi crossbred bull and one purebred Red Sindhi bull that we have trained for easy collection of spermatozoa. Several of our Jumnapari bucks are also good contributors.

This manipulation of artificial insemination has a three-fold value in our programme. We give practical demonstrations for our advanced Animal Husbandry and Dairying students; we use it for impregnating cows and goats that are suspicious for some disease which may be transmitted to the bull or buck; and we are able to use certain males more extensively during the breeding season. In one instance four goats were inseminated with the sperm from one buck in an elapsed time of ten minutes. This would have been impossible under the natural method.

We have seven young goats in our herd that have been produced by this method. It so happens that one is a female and six are males. Two of the males are twins. One kid weighed eleven pounds at birth and all appear normal in every way.—*T. W. Millen.*

Goats

The popularity of our Jumnapari goat herd has increased during the past months and many goats are being brought for service from the surrounding area, some from distances of several miles. The only females which we have sold were those which were taken over by the Rural Development Association. We have at present sixteen female kids all of which we plan to take into the herd. Our present policy is to keep all females for at least two lactations and to maintain as high a milk yield in the herd as we are able to build up by selection and line breeding.

A number of males have been sold and fourteen more male kids are still for sale. Many of the characteristics of the Jumnapari are dominant over those of the local desi goat which makes these bucks of special value. First generation hybrids are often difficult to distinguish from the purebreds. One characteristic which the local goat breeders seek and secure in these crosses is a much larger goat than that now present in the district.—*T. W. Millen.*

Sheep

The Institute maintains a flock of white, fine-wooled sheep headed by a Hissardale ram which we purchased from

Hissar last year. There is some Merino blood in our flock and we have some ram lambs born each year which show very good fleeces. We have had considerable demand for these rams for improvement of desi flocks.—*T. W. Millen.*

Poultry

Our poultry flock consists of White Leghorn and Rhode Island Red fowls. Most of the birds are under one year of age. We have made some attempt to determine whether it is possible and profitable to hatch eggs all year round. We have now hatched chickens in all months except June, but find that they appear to grow better during cooler months. We have been able to supply the demand for breeding cocks and setting eggs, but have not been able to supply female stock. We hope that within a few months hens and pullets of both breeds will be available for sale.

All our eggs are hatched in small incubators and the chicks raised in electrically heated brooders. The chicks are several weeks old before they are allowed on the ground. These methods eliminate many of the diseases and parasites which accompanied the desi hen when she was used to incubate the eggs and raise the chicks.—*T. W. Millen.*

Bees

The Institute Apiary has kept at the same time six strains of bees, namely:

(1) Apis dorsata, (2) Apis indica (hills variety).

(3) Apis indica (plains variety), (4) Kashmir bees.

(5) Apis florea and (6) the dammar bees (Melipona app.)

For the rock bees we developed a cage having perforated sides. These perforations permitted the workers to pass freely, but confined the queen. One colony made a fine comb and reared considerable brood during the four months we kept it in this cage. This is the first time this bee has been kept working in a confined cage and a world record for keeping a dorsata colony after removing it from its original

location. We were able to study these bees considerably and isolated several queens of the species. A similar cage is used for Apis florea, but with much smaller perforations.

Honey extracted from a dorsata comb by means of the solar honey extractor and preserved immediately in glass containers could not be distinguished from that secured from combs of Apis indica at the same season. We are convinced that the greatest factor responsible for the inferior quality of rock bee honey is the method of processing and storage which is in general use.

We have postponed the importation of foreign queens until more favourable times and are confining our efforts to the maintenance and propagation of the Indian bees under Allahabad conditions.—*T. W. Millen.*

(*Continued from page* 319)

the river and visitors in the hostel on Sundays all add variety which is sought for in a school programme. But on ordinary evenings during sports and walks the girls seem to be very happy and the staff report that we are all enjoying their work and are glad that we are growing. The eagerness with which parents have tried to get their girls into our Home-Making Department has shown us that we are growing in popularity and that there is a realisation of the usefulness of our course.

We sent up 11 girls for the E. T. C. examinations and out of that number 10 passed, one 1st division in practice, two 2nd division in practice. The girl who failed did so in only one subject. The Home-Making course was taken by all girls in additicn to the E. T. C. during the 2 years of study. We hope that the Intermediate course will be recognized permitting girls to go to the University for the newly planned Degree of B. Sc. in Home Economics or of remaining a year longer with us for their I. T. C.

REPORT OF THE DEPARTMENT OF BIOLOGY, 1941-42.

BY W. K. WESLEY

Staff.

Edgar F. Vestal (on furlough), Botany and Plant Pathology.

W. K. Wesley, Zoology and Entomology.

T. A. Koshy, Biology.

A. D. Chand, Plant Pathology.

T. W. Millen, Bacteriology.

General.

On the departure of Dr. E. F. Vestal for furlough, Mr. W. K. Wesley was appointed the officiating Head of the Department. Mr. A. D. Chand took over the teaching of Plant Pathology, and Dr. T. W. Millen of Bacteriology.

Besides the regular students, we gave training to several casual students from outside.

Botany and Plant Pathology.

An attempt was made to grow tapioca (*Manihot utilissima*) which met with considerable success. Besides being a food crop this is also a valuable source of starch. Efforts are being made to introduce several varieties to find out those which will be most suited to this region.

Cultures of fungi isolated from diseased plants on the Institute Farm, and reported last year, were maintained. Besides these some cultures were obtained from the Allahabad University and Imperial Agricultural Research Institute, New Delhi, for use in Plant Pathology work.

A culture of an isolation from guava about which a brief report was given last year, was sent to the Imperial

Mycologist, New Delhi, who very kindly identified it for us as a *Cephalosporium* and reported that as far he knows this fungus has not been previously recorded on guava in India. The culture is being maintained at the Imperial Institute as well as here.

Entomology.

Special observations were made on the life histories of the following four beetles and a moth which cause damage to the stored wheat and wheat flour in Allahabad and the neighbouring districts. These beetles (Coleoptera) are known as *ghun* in Hindustani, weevils in English, kornwurm in German and charancon in French.

1. The Rice Weevil or Sund wala ghun. (*Calandra oryzae* L. Curculionidae).

2. Khapra ghun, (*Trogoderma khapra* Arr. Dermestidae).

3. The wheat weevil. (*Rhizopertha dominica* F. Bostrychidae).

4. The red grain beetle or Lal ghun. (*Triboleum castaneum* M. Tenebrionidae).

5. The grain moth (*Sitotroga cerealella* Oliv. Gelechidae).

Sund wala ghun.

This *ghun* is a dark brown insect with a snout (sund). It is one-eighth of an inch long and possesses club-shaped antennae which are elbowed. The upper surface of the thorax and the elytra is pitted. It is a major pest of stored rice as well as of wheat and other stored grains. It is commonly found all over the world and has been reported from almost all the important places in India Its activities are much accelerated during the warm season.

This *ghun* may live up to eight months and cause considerable damage. The mated female lays small, whitish, oval eggs on the grain after scooping out a little bit of the

seed coat. The grub* hatches in a week or so and entering the grain starts feeding on its contents. When full fed in about two to three weeks the larva is as long as the adult and pupates within the grain as a dirty white pupa which turns dark brown in a week when the adult comes out.

Khapra ghun.

Khapra is a small dark brown *ghun* with a retractile head and clubbed antennae which are attached in pockets on the lower side of the thorax. The female *ghun* is one-tenth of an inch long and bigger than the male. These insects are very common here as well as all over India. In the absence of wheat they feed on other grains also. During the hot months the mated females lay small white eggs on the grain which hatch in about a week. The reddish brown hairy larva banded with yellowish brown colour and possessing a long bushy tail feeds on the grain and is full fed in about three weeks or a month when it pupates among the grain as a dark brown object. Within a week the adult is fully developed and comes out. It is most destructive during the rainy season when it abounds mostly in the upper layers of the stored grain.

Gehun ka ghun:

This *ghun* is about one-eighth of an inch long. Its colour varies from brown to brownish black. The head is deflexed and covered by a crenulate hood-shaped pronotum. The antennae are clubbed which are tripartite. This *ghun* is also quite common here as well as elsewhere in India. It has been reported feeding on a variety of materials *e.g.*, biscuits, wood, etc., but it is very destructive to stored wheat whenever it finds access to it. The fertilized females lay a large number of small white eggs early in the summer season on the grain which hatch within a week or more depending upon the temperature. The larva which feeds inside the grain is full fed in about two months when it is

*The first stage in the life history of a beetle is known as an egg, the second stage as a grub (larva). The larva stage is the stage of feeding and growth in insects. When full fed the larva changes into a pupa which does not feed but during this period of time metamorphoses into the adult beetle.

as big as the adult. It is cream coloured with constricted abdomen and light brown head. The pupa is light brown which is also formed inside the grain. The adult is more harmful than the grub and is at its worst in the rainy season.

Lal ghun.

This *ghun* is about one-sixth of an inch long and red to reddish brown in colour. It is very common in wheat flour and in grain that has been attacked by other insect pests. It has also been seen attacking pistachio nuts. The affected flour starts smelling bad and the preparations made from this flour are also distasteful and unwholesome. The female *ghun* lays small whitish eggs in the flour which hatch in about three days into elongated, cream coloured hairy larvae very common in the rainy season. They feed on the flour and pass the excreta in it for about three weeks when they become full fed and pupate. The pupa case is also cream coloured from which the adults come out within a week.

The Grain moth.

This moth is a very bad pest of stored grains, *viz.*, wheat, maize, rice, and juar. The moth is straw coloured with a satin lustre and a wing expanse of about three-eighths of an inch. The wings are delicate, pointed and fringed on the hinder margin with fine hair. The head and the thoracic regions are dark brown. The antennae are long and slender. The eggs are small, rounded, white at first, changing to pink colour later on and are laid on or near the grain. They hatch in about a week and the newly hatched caterpillars bore into the grain where they feed on its contents. They are full fed in about two weeks and pupate within the grain in a silken cocoon. After about a week the moths come out and mate. The moths are quite harmless and short-lived and are seen coming out in large numbers.

Fumigation with carbon bisulphide or calcium cyanide has met with some success in controlling these pests.

Other pests. Other observations made were as follows:— *Oxyrachis tarandus* was observed on carandus besides brinjal.

In addition to the common food plants *Zunabris pustulata* T. was also seen damaging salad and citrus leaves.

Casual observations recorded on *Diaphorina citri* Knw. were published in "The Allahabad Farmer" Vol. XVI, No. 2 March, 1942 *

Life histroy of *Leucinodes orbonalis* G. was observed on brinjal and the observations published in "The Allahabad Farmer" Vol. XVI No. 4, July, 1942*

Nephantis serinopa M was collected from palm leaves. Further observations are carried on

A special collection of Papilionidae of Allahabad is being carried on and the work will be published as soon as it is in shape.

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* The articles have also been reprinted in the United Provinces Fruit Journal [Editor]

(*Reprinted from "The Allahabad Farmer," Vol. XVI, No. 5, Sept.,* 1942)

The Mission Press, Allahabad.

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REPORT OF THE DEPARTMENT OF AGRICULTURAL ECONOMICS, 1941-42

By

DR. SAM HIGGINBOTTOM AND H S. AZARIAH.

Personnel:—Mr A. Dayal Chand was assisting in the department till October, 1941, when he was relieved by Mr. Henry S. Azariah. Mr. Azariah returned to the Institute after two years of advanced study in Agricultural Economics and Rural Sociology in Cornell University (U.S A.). He was granted the degree of M.Sc.

Educational Activity:—The main work of the department is teaching. About two years ago, a course in Principles of Economics was introduced to the first-year class; and, last year, a course in Agricultural Economics to the third-years. Formerly the second and the fourth year classes received instruction in Economics: now, all the classes are studying the subject, and, therefore, the distribution is much better. It will take some time before the benefit of this arrangement can be seen in the results of the final University and the Board examinations.

Compared to last year, the results of the final examinations were very good All the students passed successfully in Agricultural Economics in the final university examination. In the Intermediate Board examination, however, three out of thirty-three failed to pass in Principles of Economics. These students failed also in more than one subject.

Unlike some other Indian Universities, the teaching of Farm Management is under this department. Farm management to-day is recognised as a part of Agricultural Economics. Pedagogically, this arrangement has been found very helpful.

Research:—Until last year little research was attempted by this department. This does not mean that the department was not aware of the importance of such work. Unfortunately, it neither had a sufficiently large personnel nor the necessary funds to undertake much special investigation. Research in Agricultural Economics is a necessity. The information obtained from any project will be useful not

only to the student but also to the farmer. Factual data to illustrate the principles in Agricultural Economics, and especially in Farm Management are sadly lacking in India. A great deal has been written by arm-chair investigators or by economists who have little first-hand knowledge of Indian agriculture, and, these frequently state "opinions" which often differ from the facts. Teaching cannot be done efficiently, unless more time is given to research Sometimes the need may not be so much for getting original data, as for organizing and analyzing that already available. The department with the help of Mr. C. V. Thomas, a B Sc. student and a member of the labour crew, calculated the index of seasonal variation in the price of wheat, rice, gram, arhar dal, cotton, linseed, maize, barley, and sugar (raw) in the United Provinces. These calculations and the charts are based for the ten-year period of 1931-40. It may be noted that the seasonal variation of some commodities as found in the Marketing Reports of the Imperial Council of Agricultural research, are based for the five-year period of 1931 to 1935; and, therefore the result obtained by this department is of additional value. A report of this work will be published soon so as to make it available to those interested. Dot maps are also being prepared for the United Provinces showing the distribution of various crops and livestock. These dot maps show the concentration of various enterprises in the different parts of the United Provinces; and for teaching purposes, these will be of value.

A great deal needs to be done in this field: but the greatest handicap just now is the lack of adequate funds. Most of the work involved in the statistical analysis of factual data cannot be done efficiently without an adding machine. Such data will be useful to the student, the farmer and the government

The Institute itself is a suitable project for research into many aspects of farm economics. It has a record of accounts with every crop and every field for the last fourteen years It also has records of cost of production of mills. It has tried out many implements and methods to see whether crop increase is possible. It has experimental plots. Were all the material here available subjected to economic analysis and interpretation much valuable factual material might be brought to light

REPORT OF THE CHEMISTRY DEPARTMENT, 1941-42.

By

A. P. Brooks

Staff:—The Chemistry Department staff has remained the same throughout the year Mr. Brooks continued in charge as head of the department, Dr. B. B Malvea, of Ewing College, continued to give lectures in advanced theoretical chemistry, while Mr. C. O Das and Mr. J C. Gidecn had charge of the laboratory work and of lectures for beginning classes.

Equipment and Supplies:—The department was fortunate in having had on hand nearly a sufficient amount of the larger pieces of apparatus needed to carry cn the regular work Several pieces of apparatus needed to ease congestion and help out a little were ordered nearly two years ago but delivery has not yet been secured, and now seems doubtful for the period of the war. The laboratory has also had on hand sufficient supply of glassware and chemicals so that the normal activities have not had to be curtailed. However, replacements orders for the forthcoming year have been difficult to fill, and there may be a shortage of a few items.

Inability to secure new equipment and special reagents has limited the ability of the laboratory to undertake certain investigations or research which would have been desirable.

Activities:—The department is mainly concerned with routine teaching. In all, six classes of chemistry are taught, each with its requisite amount of lectures and laboratory work. This includes two classes of Intermediate chemistry, two classes of B Sc. Agriculture chemistry, one class of B.Sc. Dairy chemistry, and one class of I D.D. Dairy chemistry. In addition facilities are offered to the Home Making Department to give the girls instruction in a certain amount of chemistry in connection with their courses in foods, nutrition,

and cooking. The department provides an average of about fifteen hours of lectures and twenty hours of practical work per week. It is estimated that every hour of practical class work requires more than an hour and a half of preparation on the part of the staff. This is particularly true of the advanced courses in agricultural analysis where many accurately standardized solutions are needed and where many samples of analytical material have also to be analyzed by the staff in order to ensure accuracy and to check the student results

In addition to teaching activities the department is interested in carrying on such research and minor investigations as it has time for and is able to undertake with the facilities at its disposal. During the past year several samples of water have been investigated. Samples of compost and manure were analyzed for nitrogen, phosphorous and potash. Several samples of pure *ghee* and vegetable *ghee* have been investigated for purity and their chemical constants determined. In this connection we have also been accumulating data on the constants of pure cow *ghee* and pure buffalo *ghee* from the Institute herds in order to eventually learn the limits of variability of cow and buffalo *ghee* of our herds. The constants usually determined are the Reichert Meissl number, the iodine number, and sometimes the saponification number.

In the late spring we were asked to co-operate with Government in the investigation of certain soils in connection with military requirements for aerodrome sites. The department was able to aid in the determination of the pH and other characteristics of various soil samples brought in for test.

Samples of limestone from Kashmir and Jaipur were analyzed in detail to serve as samples for student practical work. As a side line five collections of geological specimens were assembled and mounted and carefully labelled for display at the farmers' fair and on other suitable occasions. Two of the fossil collections are unusually complete and one at least may be presumed to be superior to any other of its kind in India.

UNITED PROVINCES DEPARTMENT OF AGRICULTURE—MONTHLY AGRICULTURAL REPORTS

MAY, 1942

I—Season.—Rainfall during the month was general but unevenly distributed. Many districts received no rain at all. It was heavier in the 2nd and 4th weeks than in the 1st and 3rd weeks. It was above the normal in three districts, the district of Dehra Dun topping the list recording above 2 inches.

II—Agricultural operations.—Agricultural operations are generally up to date. Irrigation of sugarcane and extra crops and preparation of land for kharif crops are in progress. Sowing in canal-irrigated areas has started.

III—Standing crops and IV—Prospects of the harvest.—The condition of the standing crops and the prospects of harvest are, on the whole, satisfactory.

V—Damage to Crops.—Slight to moderate damage to crops by hail is reported from the Meerut, Bulandshahr, Lucknow and Hardoi District. Loss to crops amounting to about Rs. 1,566 and Rs. 1,13,200 respectively is reported from fire in the Naini Tal and Kheri districts. To a lesser extent, damage by fire is also reported from the Bulandshahr, Pilibhit and Hamirpur District.

VI—Agricultural stock.—Cattle diseases are reported from some of the districts, but the condition of agricultural stock is, on the whole, satisfactory. The figures furnished by the Director of Veterinary Services, United Provinces, tabulated below when compared with those of the last month indicate more seizures and deaths by rinderpest and haemorrhagic septicæmia during the month under report. Seizures and deaths by foot-and-mouth diseases are on the decline :

Disease.	April, 1942		May, 1942	
	Affected	Deaths	Affected	Deaths
Rinderpest	808	562	925	565
Foot-and-mouth	6,137	26	5,023	7
Hæmorrhagic septicæmia ...	122	117	207	178

VII—Pasturage and fodder.—No scarcity of either pasturage or fodder is reported from anywhere except in the Agra and Mainpuri Districts.

VIII—Trade and prices.—There has been a somewhat marked fluctuation in the prices of barley and *arhar dal* though the prices of wheat, gram and rice have been more or less stationary with a slight rising tendency. A comparative statement of the retail prices, in rupees per maund prevailing at the end of last month and at the end of the month under report is given below:

	End of April, 1942	End of May, 1942.
Wheat	5·311	5·619
Barley	3 262	4·039
Gram	4·011	4·537
Rice	7·235	7·583
Arhar dal	5·522	6·116

IX—Health and labour in rural areas.—The condition of the rural population is generally satisfactory. Outbreaks of small-pox are reported from the Etah, Shahjahanpur, Pilibhit, Ghazipur, Azamgarh, Lucknow and Fyzabad Districts. Stray cases of plague and cholera have also been reported.

June, 1942

I—Season.—The first week of June, 1942, was practically rainless. Light showers of rain were received in certain districts during the second week, and the rainfall was liberal throughout the province in the 2nd fortnight of the month. It was above the normal in 17 districts, the Naini Tal District recording the highest rainfall of 11-12 inches. More rain is still needed.

II—Agricultural operations.—Agricultural operations are in full swing. Irrigation of sugarcane and paddy continues. Weeding of sugarcane, paddy, cotton and maize is

in progress in certain districts. Preparation of land and sowing of kharif crops has also started.

III—Standing crops and IV—Prospects of the harvest. —The condition of the standing crops and the prospects of harvest are, on the whole, satisfactory.

V—Damage to crops.—Slight damage to crops by locust resulting in a loss of 2 annas in a rupee is reported from the Muttra District. Loss to crops amounting to about Rs. 13,136 and Rs. 58,323 respectively is reported from fire from the Hamirpur and Kheri Districts. To a lesser extent, damage by fire is also reported from the Pilibhit and Cawnpore Districts

VI—Agricultural Stock.—Cattle diseases have been reported from some districts, but the condition of agricultural stock is, on the whole, satisfactory. The figures furnished by the Director of Veterinary Services, United Provinces, tabulated below when compared with those of the last month indicate less seizures and deaths by Rinderpest, Foot and Mouth and Hæmorrhagic Septicæmia during the month under report :

Disease	May, 1942		June, 1942	
	Affected	Deaths	Affected	Deaths
Rinderpest	925	565	773	473
Foot and mouth	5,023	7	2,061	5
Hæmorrhagic Septicæmia ...	207	178	206	172

VII—Pasturage and fodder.—No scarcity either of pasturage or fodder is reported from anywhere except in the Muttra and Farrukhabad Districts.

VIII—Trade and prices —There has been a somewhat marked fluctuation in the prices of wheat, gram and rice though the prices of barley and *arhar dal* remained more or less stationary with a slight tendency to rise. A comparative statement of the retail prices in rupees per maund prevailing

at the end of the last month and at the end of the month under report is given below :

	End of May, 1942	End of June, 1942
Wheat	5·619	6·223
Barley	4·039	4·790
Gram	4·537	5·159
Rice	7·583	8·299
Arhar dal	6·116	6·995

IX—Health and labour in rural areas.—The condition of the rural population is generally satisfactory. Outbreaks of small-pox are reported from the Ghazipur, Azamgarh, Lucknow, Kheri and Fyzabad Districts. Stray cases of cholera have also been reported.

(*Continued from page* 342.)

Other pests. Other observations made were as follows:—*Oxyrachis tarandus* was observed on carandus besides brinjal.

In addition to the common food plants *Zunabris pustulata* T. was also seen damaging salad and citrus leaves.

Casual observations recorded on *Diaphorina citri* Knw. were published in "The Allahabad Farmer" Vol. XVI, No. 2 March, 1942 *

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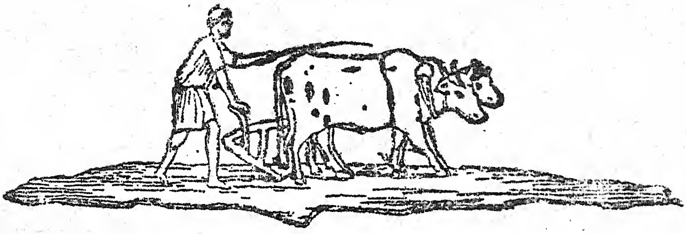
THE
ALLAHABAD FARMER



VOL. XVI] NOVEMBER, 1942 [No. 6

Editorials

Some Wisdom from the Recent Past.

One of the most interesting books on agriculture which have fallen into our hands recently is one published almost 40 years ago, and written by two army officers, Major A. C. Williams and Major D. J. Meagher. The book was published by the Calcutta office of the Superintendent, Government Printing. The book, entitled Farm Mannual, indicates that the writers were very keen students of agriculture. Their observations extended over a period of about 20 years and covered an area extending from Allahabad to Calcutta, although they were quite familiar with conditions in other parts of India. These observations, made more than 40 years ago, are still of great practical value to our present day agriculturists. We wish here to draw the attention of our readers to some of their observations.

In these days when so much is being said in foreign publications about the effectiveness of mulches, it is very interesting to note that these men found more than 40 years

ago that in order to prevent loss of moisture from his soils, the farmer "must break up and pulverize the surface of the soil or afford it shelter by laying on a layer of leaves or any kind of refuse"; although the modern idea 'that soil mulch is effective in conserving moisture only indirectly by controlling weeds' was probably not known to them.

Another observation these two writers made, to which we would like to draw the attention of our readers, is on what they call "gatha banding." This is a system of dividing the land into plots by means of earthen banks. They claim that this method is especially useful in reclaiming, waste land. Gatha banding and ravine silting were the two methods used in order to reclaim the area now known as the Macpherson Lake and Park and its environs in Allahabad. These writers, however, also admit that in many cases, especially in Lower Bengal, it is often necessary to use methods which are directly opposite to this, namely to draw off excessive rain water to prevent the deterioration of the land.

On the question as to which trees may best be grown along with grasses which may be used for fodder or for the grazing of animals – the subject in which they were particularly interested—they claim that *babul (Acacia arabica)* and *shisham* (*Dalbergia sissoo*) are the best, as grasses grow abundantly under these trees The *babul* according to them is especially useful, because; (1) its timber is most useful for making ploughs, cart wheels, country carts, and handles for hoes, *pharuas*, rubbish forks, etc., (2) it makes charcoal of the best quality, (3) its foliage and pods are good fodder for all cattle, and very fattening for sheep, (4) it yields gum, and its leaf-rot makes valuable manure, (5) it is valuable in reclaiming barren land, (6) the bark is useful for tanning purposes, (7) it grows quickly and requires no care once it is planted. Seeds of *babul* ejected by goats when chewing the cud are considered the best for sowing. The *shisham* tree, according to these writers stands next in value to *babul*, because : (1) its leaf-rot makes good manure, (2) it grows quickly and also requires little care. The writers, however, do not recommend *babul* for the berms of roads.

On the subject of ploughing, the writers made very interesting observations which we commend to all those who are engaged in the difficult task of producing improved ploughs for various regions of this vast country.

Another interesting and useful observation made by the authors was with regard to the use of town rubbish, and the disposal of night soil. As is well known, Indian soils are lacking in organic matter. Yet this very great source of organic matter is not made use of for the improvement of soils as is done in China and Japan; and, in a more scientific way, in western countries as well. The authors suggest the trenching of all town rubbish, as well as all the night soil available. For the latter they suggest a system which they call the "surface disposal of night soul," which had been sanctioned by regulation. The night soil thus trenched decomposes in less than a week, and crops can be grown immediately after trenching. For a region such as Allahabad the authors recommend that the first crop be a fodder crop of *juar*. But as such fields will not need any manuring for six or seven years, any suitable crop may be grown after *juar*. As the results of the experiments conducted by Surgeon-Colonel Martin, who was Principal Medical Officer of the Allahabad district at that time, the authors claim that this method of disposing of night soil is very satisfactory from a sanitary point of view, while at the same time very useful from an agricultural point of view.

The Chinese farmers have kept up the fertility of their soils for the last forty centuries by making use of night soil and all wastes from towns and cities, so that their land even today continues to give heavy yields of crops every year.

The authors made these and many other useful observations on various aspects of agriculture, such as grass farming, hay-making, ensiling, grazing, draught cattle, feeding of animals, diseases of cattle, swine husbandry, and farm implements and machinery, as a result of their long experience with farm work in this country. We feel it would have profited the country a great deal if such literature as this had been brought to the notice of the public.

We here in Allahabad are rightly proud of the fact that many useful agricultural experiments were carried out here in Allahabad in the early eighties—almost sixty years ago—and to know that the Macpherson Lake and Park and its adjoining areas here in Allahabad are monuments of those early experiments in the field of agricultural science.

The production of different food grains in the United Provinces during this year, 1942-43, has been estimated to be as follows :—

Wheat	75,000,000 maunds.
Rice	65,000,000 „
Gram	50,000,000 „
Barley	40,000,000 „
Maize	18,000,000 „
Jowar	15,000,000 „
Bajra	13,000,000 „
Minor Millets (kodon, mandua, kakun, sawan, etc.) ...	8,000,000 „

"From the analysis of effluent received from the Poona city sewage, it is found that the nitrogen contained in it is roughly equal to 3 lbs. per annum per head of population. The money value of these three pounds of nitrogen is equal to Re. 1-8-0, on the basis of market rates and of nitrogen contents of oil cakes, ammonium sulphate and other manures. If such valuable nitrogen is not utilised for irrigation but wasted elsewhere, the loss to national wealth due to such waste would amount to rupees three lakhs per annum for Poona alone"—*R. P. Talati (in The Indian Journal of Agri. Science, Vol. XII, part 1).*

SEASONAL VARIATIONS IN WHOLESALE PRICES OF CERTAIN AGRICULTURAL COMMODITIES IN THE UNITED PROVINCES

By

HENRY S. AZARIAH

Department of Agricultural Economics, Allahabad Agricultural Institute

Fluctuations in prices have affected the economic life of man so much that more and more attention is being paid to the study of the price phenomenon. Broadly speaking these fluctuations can be studied either for a long period of several years or for a short period of one year. Agricultural commodities exhibit a regular pattern of variation which is due solely to their supply. This type of fluctuation is known as the seasonal variation in prices of the commodities, because it is the season of harvest or sowing which affect the price of these commodities.

Importance of Index Numbers

In order to study the fluctuations in prices, an accurate unit of measurement is needed. Gold, which is generally considered as the standard measure of value, fluctuates violently in value especially during and immediately after the major wars. The economist, therefore, resorts to index numbers, because he has no other unit of measurement which is as unchanging and as fixed as a foot or a pound. An index number is just a device to measure the value of commodities accurately. In statistics, it is known as the Price-relative. It is simply the ratio of the price of a commodity at one time to the price of the same commodity at another time called the base-period; and it is usually expressed as a percentage of the latter. Index numbers not only afford a means of studying fluctuations in prices of one commodity; but also provide a mechanism whereby prices of several commodities

could be compared with one another. How can wheat quoted now at Rs. 6-8 per maund be compared with eggs at 12 as. per dozen? The answer is the use of index numbers by which the price of both could be expressed in the same way—each as a percentage of the same base period. The items would then be on a comparable basis. For example, just before the war started in August, 1939, the price of wheat was Rs. 3-4 per maund and eggs 8 as. per dozen. Taking August, 1939, as base, the index of the price of wheat now would be 200 ($\frac{6{\cdot}50}{3{\cdot}25} \times 100$), and eggs 150 ($\frac{12}{8} \times 100$). This means the price of wheat has risen 50 per cent more than that of eggs.

It is difficult to understand why in this country a dislike is shown for the use of index numbers. Writers on prices carefully avoid them. Even a few of the marketing reports published by the Imperial Council of Agricultural Research have not cared to use them. Since the purchasing power of money varies greatly during periods of inflation and deflation, it is better to avoid this variable unit in measuring fluctuations in prices. It is for this reason index numbers were freely used in this study.

How Seasonal Variations are Determined

Seasonal variations in prices of agricultural commodities, as was explained earlier, are those fluctuations in prices which are due mainly to their seasonal supply. But at any particular time the price of an agricultural commodity may be at a particular level due to long-time trend in yearly fluctuations. If the long-time upward or downward trend could be eliminated from monthly data, a pattern of fluctuations due only to the seasonal supply would be left. Statistically this is possible.

There are several methods of eliminating the secular or long-time trend. Of these perhaps the simpler ones are three: namely Simple Average method, Macauley's method and Warren's method. While the Simple Average method uses arithmetic mean to eliminate the trend, the Macauley's method employs moving average, and the Warren's method first determines the secular trend mathematically by the

method of Least Squares. In all these methods, the greater the number of observations, the more reliable will be the result.

Methods Used

Seasonal variations in wholesale prices of wheat, rice, gram, arhar dal, cotton, linseed, maize, barley and raw sugar in the United Provinces were calculated by the Simple Average method with data for the ten-year period 1931-'40; and the results are given in table 1 and in figures 1 to 9. The source of data was the bulletin No. 1 of the Bureau of Statistics and Research, U. P., 1941.

TABLE 1.

Index of Seasonal Variations in Wholesale Prices of Certain Agricultural Commodities in the United Provinces, 1931-'40.

	Wheat	Rice	Gram	Arhar	Cotton	Linseed	Maize	Barley	Raw Sugar
January ..	109	95	103	109	107	100	93	100	89
February ..	103	96	100	104	103	100	91	98	90
March ..	100	96	96	98	101	97	91	95	98
April .	93	101	95	94	100	99	92	96	95
May ..	91	105	97	91	94	100	104	97	96
June .	93	103	94	97	92	100	107	97	101
July ..	97	102	99	99	94	102	114	102	103
August .	101	105	102	97	96	101	117	105	107
September ..	100	105	102	101	97	99	99	104	111
October .	103	101	103	104	102	101	94	104	108
November ..	104	96	105	103	106	100	99	100	106
December ..	106	98	104	103	109	100	98	105	96

Indices of seasonal variations in wholesale prices of wheat were computed by the Warren's method also. The yearly equation of secular trend was y = Rs. 4·435 — Rs. 0·0228x; and the monthly decrease was 0·002x. This correction was applied to get the indices of seasonal variations in the price of wheat. There was not much difference in the result obtained, as shown in table 2.

TABLE 2.

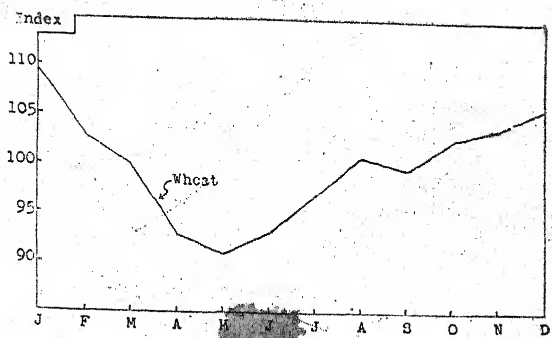
Comparison of Seasonal Variations in Wholesale Prices of Wheat by two different methods.

	Simple Average	Warren
January	109	109
February	103	103
March	100	100
April	93	94
May	91	90
June	93	93
July	97	97
August	101	101
September	100	100
October	103	103
November	104	103
December	106	106

To the research student, the results from such studies as this will be useful to eliminate from a monthly series the effect of seasonal variation so as to bring into clear relief any underlying cyclical movement that may be in the data. To the Controller of Prices, this would indicate when he could expect the price of a particular commodity to rise, and when the price will automatically go below his "ceiling price." From farm business point of view, seasonal variations in prices of agricultural commodities complicate the problem of management. However, the fact that they occur regularly makes it possible to forecast accurately and effect the necessary change. For example, to decide wisely the best time to sell a crop, one must not only know the nature of the demand for the product, the size of the "crop" and the expenses involved in holding, such as that due to handling, shrinkage, spoilage, interest, and risk against loss, but also the seasonal variations in the price of the particular product. The indices and the figures are based on data for the whole of the United Provinces; and therefore, in using these charts this fact should be kept in mind. In general, prices of agricultural commodities fluctuate more violently in surplus or producing areas, and less in consuming areas: and retail prices are slower to respond to changes than wholesale prices.

FIGURE 1

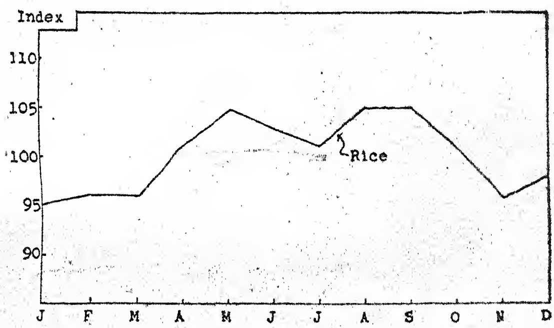
Seasonal Variations in Wholesale Prices of Wheat in the United Provinces 1931-40.



Prices of wheat in December and January are generally high.

FIGURE 2

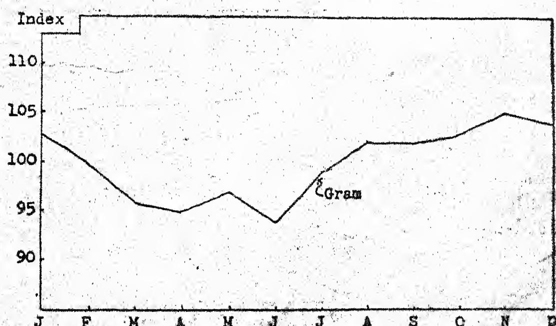
Seasonal Variations in Wholesale Prices of Common Rice in the United Provinces, 1931-40.



Prices of rice, however, are usually low from January to March and are high in May and September.

FIGURE 3

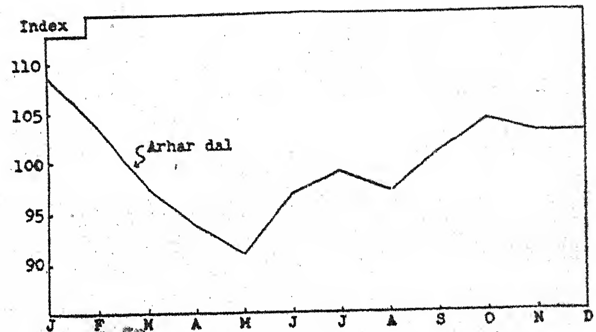
Seasonal Variations in Wholesale Prices of Gram in the United Provinces, 1931-40.



Prices of gram are lowest in June and highest in November.

FIGURE 4

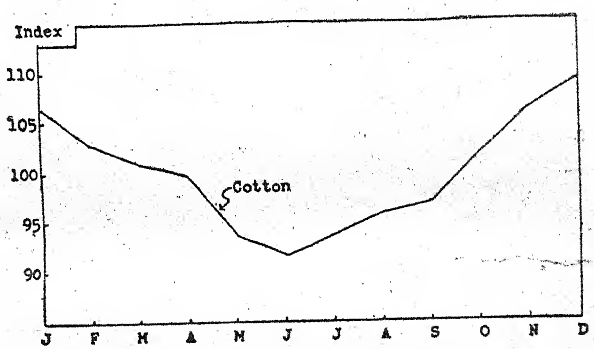
Seasonal Variations in Wholesale Prices of Arhar dal in the United Provinces, 1931-40.



Prices of arhar dal fluctuate more than that of gram. Lowest prices of arhar are reached in May and the highest in January.

FIGURE 5

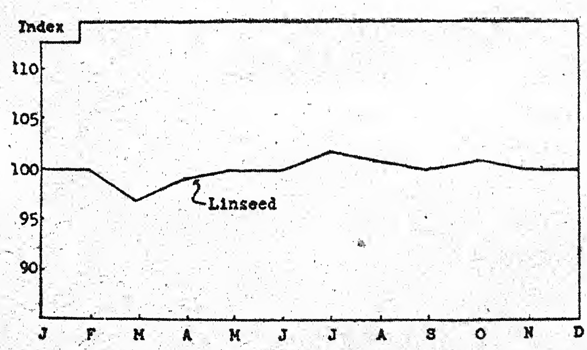
Seasonal Variations in Wholesale Prices of Cotton in the United Provinces, 1931-40.



Cotton fluctuates very much. The lowest price of cotton occurs in June.

FIGURE 6

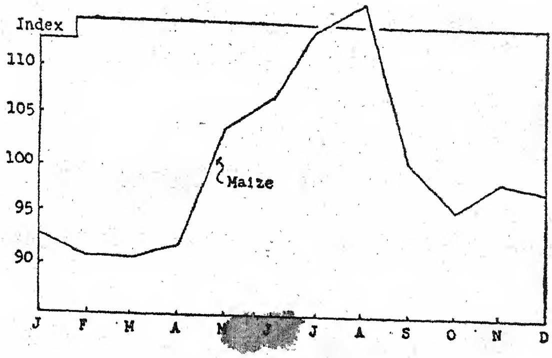
Seasonal Variations in Wholesale Prices of Linseed in the United Provinces, 1931-40.



Price of linseed does not fluctuate much.

FIGURE 7

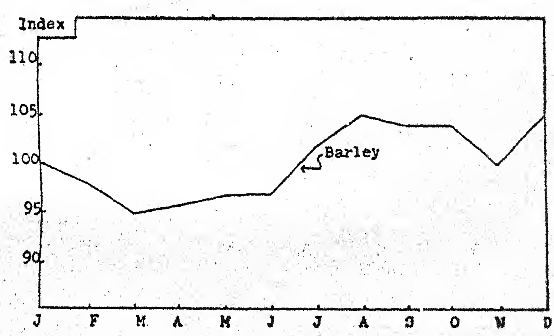
Seasonal Variations in Wholesale Prices of Maize in the United Provinces, 1931-40.



Price of maize fluctuates violently. In the first four months of the year it is generally low; from April it rises rapidly until the harvest of the new crop in August-September.

FIGURE 8

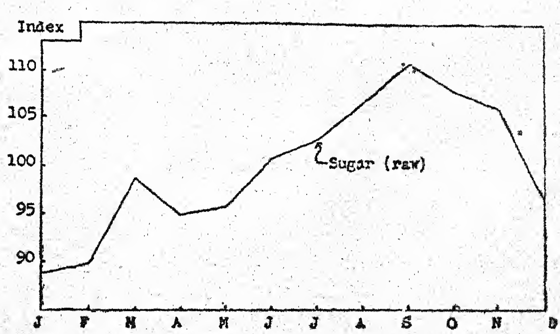
Seasonal Variations in Wholesale Prices of Barley in the United Provinces, 1931-40.



Price of barley remains below the annual mean during the first six months of the year.

FIGURE 9

Seasonal Variations in Wholesale Prices of Raw Sugar in the United Provinces, 1931-40.



Sugar prices fluctuate violently. Prices in January are about 10 per cent below, and that in September 11 per cent above the annual mean.

A NOTE REGARDING THE USE OF SINGLE BULLOCK IMPLEMENTS.

By

M. Vaugh

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For certain operations on farms, one bullock is more convenient than a pair. This is particularly true of such operations as interculture with the ordinary type of bullock hoe. In this operation, it is necessary to have a special long yoke to allow the bullocks to walk in the adjoining middles or there is trouble with the bullocks trampling on the plants if the ordinary length yoke is used. In addition to the necessity of investing in a special yoke, the bullocks are somewhat disturbed when the length of yoke and therefore the distance between them is changed and when they are widely spaced they may be somewhat more difficult to control. Workmen often demand two men to work a cultivator when a pair of bullocks are used to work a cultivator, one to drive the bullocks and another to handle the implement. Many of these difficulties would be reduced or eliminated if a single bullock could do the work.

The ordinary yoke used with a pair of bullocks has the advantage of extreme simplicity of construction and of working. The single wooden beam or chain between the two bullocks offers the least possible chance for the bullocks to get tangled up and is the simplest device for the driver to keep clear. It does however require two animals and they must be fairly well matched in both size and strength if they are to work well together.

Various people have worked at the problem of hitching a single bullock to the implement. Some 15 or 20 years ago, the Bombay Department of Agriculture developed a wooden yoke, U-shaped and made of three pieces of wood fastened together with iron pieces. This was put on the neck of the animal in such a way that it distributed the

load between the back of the neck where the yoke commonly rests and the shoulders where the horse harness puts the pull. The two chains or ropes were attached in such a way as to distribute the load between the neck and shoulder. Such a yoke, if carefully made and fitted to the individual bullock with which it is to be used; is doubtless a useful device. It has the disadvantage of putting the pull on the shoulder and many bullocks do not have shoulders very well adapted to pulling.

This wooden yoke is an adaptation of the collar and hame harness used in Western countries for horses. In central Europe, where bullocks are still used, the collar and hame horse harness is quite commonly used on bullocks also. While the ordinary horse harness can be used on bullocks also, the shape of the neck is slightly different and the bullock should take most of the pull on the back of the neck or on the hump while a horse should take none there. This means that the point of attachment of the traces should be different, higher for bullocks than for horses. While such a harness would doubtless be excellent for use with bullocks if the collar were fitted to the bullocks' neck, the harness is relatively costly and the making of the collars requires skill not available in India at present

In 1938, the Madras Department of Agriculture published leaflet No. 85, describing an improved method of yoking single bullocks with a leather harness in which the pull is taken by a broad leather strap across the back of the neck or hump. There is also a leather strap around the body and one under the neck in the original harness which serve only to keep the harness in position on the bullock. At least with animals having a high hump, the strap under the neck is not necessary and if fastened too tightly it will cause the bullock discomfort by partially shutting off the windpipe. This is somewhat of an average between the European horse harness and the Bombay wooden single yoke. It probably will give the bullock greater comfort than the wooden yoke but will cost slightly more. It will be much cheaper than the European collar and hame harness but probably does not distribute the pressure quite as effectively. It appears to distribute the pressure far better,

however, than any wooden yoke. Harnesses made to this pattern recently at Allahabad with war prices on material have cost around Rs. 10 each. At pre-war prices, the cost would be little more than half of that amount.

In the February, 1942 issue of Indian Farming, a head yoke is described. This is reported to have given good results measured in the pull the bullock is able to exert on a load. This type of harness, if well made, will cost probably somewhat less than the Madras leather harness, about the same as the Bombay wooden yoke, probably. This is used to a limited extent in central Europe and in Spanish speaking countries, mostly for teams, but also for single animals. (Any of these single bullock harnesses can be used for pairs by the use of a suitable "double tree" between the bullocks and implement.) While no comparative trials have been made as yet with these various types, the head yoke seems to have obvious difficulties. The worst of these is the restraint of the freedom of movement of the bullock's head. This would be especially bad for the type of yoke where the two animals have the yoke lashed to their horns making it entirely impossible for one to move except as the other moved also and making some movements impossible as long as the yoke is in place. This restraint of movement is less with single animals than with pairs on a single yoke but is still very real and objectionable.

Of the three, the Madras leather harness seems to offer the best combination of cheapness, comfort for the bullock, ease of exerting his full strength and comparative freedom from probability of getting entangled. Recent trials of the harness at the Agricultural Institute, Allahabad, indicate that man and bullock quickly learned to work with it.

In addition to the problem of interculture mentioned above, there are other conditions where a single bullock might be used to advantage. There are in places very small holdings, the work on which does not justify the keeping of a pair of bullocks. In some cases these are farmed by part-time cultivators who have other jobs, in some cases they are full-time family holdings. In such cases, the cultivator may have one bullock and be dependent on finding another person with one animal with whom he can combine or he

may have to hire a pair of bullocks. Either solution makes him dependent on the convenience of others and hampers his freedom of doing his work at the time it suits his convenience. For such men a single bullock offers definite advantages if it is possible to carry out the work with one animal.

Recent tests carried out at the Agricultural Institute indicate the practicability of such working. No dynamometer was available for definite draft tests. The tests were made with a Shabash plough in a field of light loam soil from which a crop had been recently harvested but which was moist from winter rain and in excellent ploughing condition. Under these conditions, the plough used would have been a full load for a small pair of bullocks weighing about 500 to 550 lbs. each or 1,000 to 1,100 lbs. for the pair. A medium size bullock weighing 800 lbs. was used with the Madras harness and a Shabash plough with a short wooden beam. The bullock was apparently just about fully loaded, that is he was doing as much work as he could do for a full day without excessive fatigue. Estimates were made of the feed needed by a pair of animals of suitable size for the plough and for the animal used in the test which showed an annual saving in feed of about 50 maunds of fodder. * This will be of varying value according to saleability of fodder and price but it represents about half the fodder necessary to keep a cow for the year or enough to keep three goats or sheep. If a Scindhi cow is used instead of the single bullock, she should be able to do the necessary work on small farms up to 3 or 4 acres and in addition give considerable amounts of milk and *ghi* for the use of the family.

It should be again noted that the use of single bullock or single cow implements is not recommended for larger farms. Wherever the area is sufficiently large, it is better to use the pair of bullocks together and to have them controlled by one man, rather than to use them separately requiring two men. A single strong bullock should be able to do the work with modern implements on 5 to 6 acres without difficulty and possibly on more with careful planning of operations.

*[The assistance of Mr. N. R. Joshi of the Animal Husbandry Department and of Mr. P. K. Bhargava of the Engineering Department of the Institute is gratefully acknowledged in the preparation of the estimates of fodder saved.]

A SHORT NOTE ON THE CULTIVATION OF SUNFLOWER

BY

SUDHIR CHOWDHURY

The sunflower, *Helianthus annuus* Linn, belonging to the natural order *Compositæ* is generally grown as a garden crop all over Assam for its large beautiful flowers. But on account of scarcity of fodder for cattle a few cultivators have started growing this as a fodder crop, the crop being fed raw. In America it is grown extensively as fodder. the entire plant is used for feeding green or dry and for ensiling.

In this note the methods of cultivation of this crop are described in brief.

Soil.—The sunflower will grow on all classes of soils from heavy clays to poor sands but will give the best yield on loamy soil with plenty of humus in it. The land should be fertile, and especially rich in humus and nitrogen as the crop exhausts the nitrogen of the soil in producing the large amount of protein stored in the seed. The crop has been found to succeed on alkali soils in California.

Preparation of the Land.—The preparation of the land should commence after the first good shower of rain in May or June. Good ploughing and proper preparation of the seed bed so as to obtain a fine even tilth are most important if the best results are aimed at. It is of the utmost importance that the soil should be turned to as great a depth as possible up to 8 or 9 inches, having proper regard, of course, to the danger of turning up the sub-soil and also the cost of the operation.

Varieties.—There are four principal varieties of sunflower in cultivation: (1) the small-seeded Black Russian; (2) the large seeded Black Russian; (3) the Striped or Common, with striped or grey seed; and (4) the White-seeded.

Planting.—Sunflowers may be planted or sown in May or June when maize is planted. It may also be planted later than maize as it matures more quickly, being ready for harvest about one month before maize planted at the same time.

Sunflower seeds may be sown broadcast or drilled in rows about 3 ft. to 3½ ft. apart by means of any of the maize planter. About 40-50 lbs of seeds per acre are required if broadcasted and 10-12 lbs. if drilled. The seed should be planted in moist soil if possible, at a depth varying between 1 inch on heavy wet soils to 2½ inches on the lighter sandy soils. When drilled to insure a good stand the seeds should be dropped three to four inches apart in the drills, and later the plants should be thinned to 12-18 inches apart in the row. Thinning should be done when the plants are about 6 inches high.

Cultivation of the Crop.—Cultivation should be carried out often enough to keep the weeds under control until the plants have attained a height of about 1½ to 2 ft. when the shade thrown by the crop is usually sufficient to discourage further weed growth. During the first 2 to 3 weeks of their life the growth of the seedlings is slow. If after heavy rains a crust forms on the soil surface it should be broken up by cultivation to render the soil again receptive of moisture, and to create a mulch to prevent undue evaporation of moisture already in the soil.

If the crop is planted in rows any suitable type of maize cultivator can be used; if sown broadcast manual labour will have to be employed.

Harvesting.—The crop matures in 4 to 5 months depending on the conditions of the season and soil. The seed heads should be harvested before they are quite ripe. As soon as the seeds are ripe they begin to shatter and before the crop is mature it is likely to be damaged by birds. As the crop usually matures unevenly it may be necessary to go through it two or three times.

The heads should be cut off by hand with a sickle or other suitable implements and laid face up on the ground for

a few days to dry. One labourer can cut a half to three-quarters of an acre a day including the cutting of the stems at ground level.

For making silage the crop should be harvested when the flower heads are well developed and the petals are beginning to wilt.

Threshing the Heads.—As the heads dry out the seeds become loosened and are beaten out with sticks. An alternative method of threshing is to rub out the seed on fine-meshed wire netting stretched suitably on a wooden frame.

The seed should be thoroughly dried in the sun and then bagged or stored in bins.

Yield.—By the reports of farmers who have grown it an average yield appears to be 1000 to 1500 lbs. of seed per acre. The yield of green matter per acre is 110 to 140 maunds.

Uses.—The seed is used largely as a food by the peasants of Russia. On crushing the seed yields an oil of the drying type, which is used for lubricating and table purposes, for the making of the finer soaps and candle making. The oil is also used in the manufacture of paints and varnishes.

The unhusked seed is largely used as a poultry and fancy bird food. When crushed and mixed with other feeds it forms a valuable ingredient of the rations for cattle, sheep and pigs. The analysis of the unhusked seed is approximately as follows:

Dry matter ...	... 93.1 per cent.
Soluble carbohydrates	... 23.1 ,, ,,
Crude protein ...	... 18.5 ,, ,,
Crude fat ...	... 21.5 ,, ,,

The leaves can be fed to cattle, sheep and pigs. The composition of the leaf is approximately as follows:

Water ...	... 14.87
Ether extract (fat)	... 2.82
Protein ...	... 16.50
Carbohydrates ...	... 42.15
Crude fibre ...	... 7.87
Ash ...	... 15.79

Sunflowers make excellent silage, nutritious and palatable, but care has to be exercised in the making of it. If used alone for this purpose, and if the plants are not sufficiently mature the resulting silage may be too sour. On the other hand if the crop is too ripe the lower parts of the stems become too dry, fibrous and unpalatable. The best sunflower silage is made from sunflowers on which the flower heads are well developed and the petals are beginning to wilt.

Compared to maize sunflower makes an inferior silage. But one most important point to be borne in mind as regards sunflower silage is that sunflowers can be grown successfully where the season is too short or the rainfall too light to produce a heavy maize crop.

Sunflower silage has very often been found to become sour and so it has generally been found advisable either to mix sunflower with other crops in the silo, or to feed about one part of sunflower silage with two parts of maize silage.

Where bees are kept for profit, the large flower heads of the sunflower are most important as a source of honey. No plant produces finer honey and wax.

The World's Record Milk Producer.

Carnation Ormsby Fayne 1639621, a Holstein-Friesian of the Carnation Farms (U.S.A.), completed a year last May 20 with 41,943·4 lbs. of milk and 1,392·4 lbs. of fat.

This is 5·2 times the production of Sindh Queen, the Red Sindhi cow at the Allahabad Agricultural Institute Farm, which twice won the distinction of being the best Red Sindhi cow at the All-India Cattle Show held in Delhi.

* * * *

A clergyman from a large town preached in a rural parish and was asked to pray for rain.

He did so. The rain came in floods and destroyed some of the crops, whereupon one elder remarked to another, "This comes o' entrusting sich a request to a meenister who is na acquentit wi' agriculture."

GREEN MANURING OF PADDY FIELDS

BY

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Rice cultivation is quite different from the cultivation of other types of crops, because (1) the land is prepared for the crops by a system of puddling in water, and (2) the land is kept flooded in a swampy condition during the greater part of the growing season. The puddling of land previous to transplanting affects the physical condition of the soil and produces a finer and more clayey texture. This process goes on for years and years together and tends to make the soil heavier and heavier. Because of this, the first problem involved in the manuring of rice is the question of using manure which will tend to counteract this effect. Organic manures have a beneficial effect on the texture of the soil. So the addition of a bulky organic manure, like green manure, to paddy fields is recognized as a very useful practice.

In ordinary soils the nitrogen of the manure after going through many intermediate changes, unites with the oxygen of the air to form nitric acid, a substance which is easily absorbed by the crop. But in rice soils, no oxygen being present, instead of nitric acid, ammonia is produced. And it has been found in Japan several years ago, that rice plants readily assimilate this substance; and consequently the products of the decomposition of any manures in such soils are suitable for the needs of the plant. Fermentation in rice soils being anaerobic, nitrates are decomposed and nitrogen is liberated as free gas. Since rice plants cannot make use of this nitrogen, nitrates may not be used for rice.

Green manuring is well known as the process of growing some leguminous leafy crops and ploughing the crop under to decompose in the soil. The decomposed crop adds to the

nitrogen content of the soil. The green manuring crop should be ploughed under after about 70—75 days of sowing, as found out by Dr. B. N. Singh and others of the Benares Hindu University. They found that, "On the basis of the development of the plant and its composition it is inferred that the best period for green manuring would be when adolescent stage is about at an end and when the reproductive phase commences, that is, after about 70—75 days Green manure not only adds to the manurial efficiency of the soil but it adds to the improvement of the soil texture, and promotes the growth of micro-organisms.

The nature of the action of green manuring in rice soils was investigated in Coimbatore, and it was found that after decomposition of green manure the gases escaping through and at the surface of the water in the rice fields were oxygen and nitrogen, while marsh gas, hydrogen and carbon dioxide were found inside the soil. Further investigation has proved that the evolved oxygen was absorbed by the plant for its growth. Rice though it grows in water, does not have the root characteristic of aquatic plants. The roots require plenty of aeration and this is supplied by the oxygen produced. This absorption of oxygen is only possible when there is a simple system of slow movement of water through the soil. So it is said that green manuring owes its efficiency mainly to its indirect action on the soil by increasing root aeration. So the workers in Madras have suggested that the best way of manuring paddy fields is the application of green manure with the addition of mineral manure.

Besides this practice of ploughing under of green manure crops, there is another process which is known as 'green-leaf manuring'. In this process green leaves or green portions of shrubs are brought and applied to the water-logged field where they are incorporated in the puddle with human labour. This is very often practised in Madras and Ceylon. This process is more advantageous than the other only in one respect, namely because here the green leaves from both leguminous and non-leguminous crops can be used. It was also found out by Dr. B. N. Singh and others that leaves have the highest manurial efficiency. This process is also economical and beneficial.

The value of green manure is most beneficial in soils of average fertility containing less than 0·07 per cent of available nitrogen and less than 0·06 per cent of phosphoric acid. The result varies in different localities. While in soils above the average level of fertility it has been about 8 to 10 per cent, but on poor soils and of average fertility the increase recorded has been to the extent of 20 to 25 per cent. The cost of growing a green manure crop is comparatively low, and it has been found to be the most economical method of fertilizing rice fields. From the figures available in the different experimental stations in Madras, the cost of growing an acre of green manuring crop is about 7 rupees, which includes the cost of labour, seed, plough man and other accessories.

There are many green manuring crops that are used in India in different localities. The green manuring crops that are used in different places depend upon the climatic conditions and types of soil. The principal crops that are used for green manuring are :—

1. *Sunnhemp* (*Crotolaria juncea*). This is perhaps the most popular green manuring crop in India. It is grown almost all over India with good results. In the United Provinces it is the only green manuring crops used. It has a very rapid growth with plenty of leaves. It can be sown in rice fields in April and May and can be ploughed under in June and July when there is enough of water to decompose the vegetative portions. The process of decomposition takes only about four weeks. The seed rate for this crop is 15 to 20 lbs. per acre.

2. *Wild Indigo* (*Tephrosia purpurea*). This is the most valuable crop because of its hardiness and drought resistance. It thrives best in loamy or slightly gritty soil but not in very heavy soil. It is a slow growing crop, and is sown in March or April. This crop is ploughed under in July or August when there is enough moisture. This is not as good as sunnhemp, but it is preferred because of its hardiness and because cattle do not eat the leaves. So it can be grown in open fields. The seed rate is 10 to 15 lbs. per acre.

3. *Daincha* (*Sesbania aculeata*). This is a valuable green manure crop on heavy soils and especially on lands inclined to be saline. It is a drought resistant plant and at the same time can withstand wet condition. It is usually sown in May and June, and after three months is ploughed in to decompose. The crop should be ploughed under a little earlier because it tends to get woody which will delay in decomposing. The ordinary seed rate is 10 to 12 lbs. per acre.

4. *Indigo* (*Indigofera tinctoria*). Like wild indigo this is slow growing in the beginning but bushes well later, if there are any summer showers. It thrives best in loams and clay loams. It is drought resistant and has a deep root system. This crop is sown in December and January after the harvest of rice, and then is ploughed under in June and July to act as manure. The seeds are hard, and so are treated either with sulphuric acid or with some machine which act on the seed coat before sowing. The seed rate is 10 to 15 lbs. per acre.

Besides these there are many other leguminous crops used as green manure, but these are the principal ones used in paddy fields.

Rice is one of the principal crops of India. In these days of war India needs more food products, especially rice, in some parts of the country, without which people will starve. So in order to increase the production of rice, the application of green manure supplemented with mineral manures is highly desirable.

"You think of a girl as a perpendicular biological phenomenon in short skirts. How do you know that she is not an oval mass of bent space being thrown off like electrons from swiftly rotating nitholwatts with all the speed of an idzol ?"—*Albert Einstein.*

* * * *

" Skill to do comes by doing, knowledge comes by eyes always open and working hands and there is no knowledge that is not power."—*Emerson.*

OBSERVATIONS ON THE STEM BORER OF PADDY, SCHOENOBIUS INCERTELLUS WLK., IN COCHIN

By

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The stem borer, *Schoenobius incertellus* Wlk., occupies a foremost place amongst the pests of paddy in the State. It is present throughout the year, but generally the crops grown from September to December, and from January to May, known locally as the "mundakan", "puncha" and "kole" crops, suffer the heaviest damage. The first season crop of paddy taken during the south-west monsoon period, May to September, is fairly free from infection; but even then, especially if the variety be one of long duration, the pest becomes very marked towards the later stages of the crop.

As a prelude to the infestation, one can observe moths resting on the plants at almost every step in the field. The moths, especially the females, lend themselves to easy recognition from a short distance. When disturbed, they show no tendency to fly far, but settle nearby. When there is standing water in the field and the plants are young, the dead bodies of the moths which have oviposited and their wings, can be seen floating in tens and hundreds towards the leeward margins of the bunds.

The moths are seen to be very active at night, when one walks along the field with a light. They are also attracted to the light in large numbers. In homesteads near fields, the moths are sometimes a nuisance, hovering round lights and falling into dishes and cups. The electric light posts along roads passing between rice fields, can be seen to be dotted with the moths; and when the posts are painted black, as happens to be the case on some State roads, the yellowish colour of the moths forms a pattern against the dark background. Thus lights near fields supply a warning of the impending infection. Moths are generally attracted between eight and ten o'clock in the night. Very few moths are found attracted after ten o'clock. Moths are found attracted to light even on moon-light nights.

The egg masses are very conspicuous objects on the leaves of the plant, and are easily spotted. These egg masses can be nipped off from the leaves in a short time from a heavily infested field. Eggs are also found on electric light posts below the bulb. They are also laid on the walls and in ceilings of houses near lights.

The eggs are parasitised by a minute chalcid, *Trichogramma indicum* R., and those laid in the hot months of January and February are found to be more parasitised than at other times.

The first symptom of attack in the young field is the wilting of the central shoots of the plants followed by a browning and drying up of the surrounding leaves. The "yellowing" of the whole field is what faces an on-locker from a distance where there is severe infestation. In less severe infestation, patches of the crop at various parts of the field are noted to turn brown and dry. In mild attacks, plants, here and there, have their central shoots withered, and the damage is discernible only on closer inspection. Many a farmer in the State is under the impression that the drying up of the plants, is due to some injurious nature of the soil resulting from water stagnation, want of aeration, etc. "White ears" are characteristic of the damage in the later stages of the crop.

The caterpillar attacks the plants in all stages of their development. In young plants, the caterpillar bores at the base, and enters the central portion. It is also seen to tunnel inside the thick and fleshy basal portions of the outer leaves. In the case of older plants, the larva enters the stem by boring a little above the topmost node, and tunnels its way down to the base of the plants by cutting through the internodal portions. Even when the ear heads have come out and become half ripe, the caterpillar attacks the plant. The grains remain half developed in such cases. There is only one caterpillar in a plant as a general rule. In very rare instances, two larvae may be noted in the same plant. An Ichneumonid wasp occasionally parasitises the pest in its larval stage.

The commencement of fresh generations can generally be detected by noting the attraction of moths to light in increased numbers. Moths are seen in small numbers

throughout the year, but in any locality one notes that increased attraction occurs at intervals of about five weeks.

Fields with standing water invariably suffer heavier infestations than dry ones. The lowermost fields in an area, where drainage is difficult, therefore, are the first to get the attention of the borer. The attack is rare in nurseries where seedlings are raised for transplantation, since high level, dry areas only are made use of for such nurseries. It has been demonstrated on many occasions, that in fields which are completely drained immediately the wilting of the shoots becomes apparent, the progress of the attack is largely checked and the revival of the crop facilitated.

The collection of egg masses and the adoption of "light" traps have only been carried out on a limited scale. But these measures, when adopted extensively, seem to offer definite possibilities of control

Ploughing the entire field and destruction of the stubbles of the previous crop, before a new one is put in, is not very practicable since there is rice cultivation all through the year.

When attacks are noticed in the young field, the immediate course is to drain it as completely as possible. The gaps created by the pest are then filled out with seedling from the denser portions of the field, or with fresh seedlings from the nursery, if available. These measures are more advantageously carried out in cases where the farmer has sown or transplanted thickly, or has provided a reserve of seedlings in the nursery as an insurance against borer damage. Hence the farmer who is accused of not economising his seed suffers less, whenever there happens to be a borer attack.

After draining and filling of the gaps, wherever possible, an application of Nicifos or Ammonium Sulphate at the rate of about 80 to 100 lbs. per acre, provides for the increased vigour and tillering of the plants, leading to the revival of the crop. In place of the chemical manures, prawn dust which is produced in the State, mixed with ashes at the rate of one cwt. per acre is also being used This is slower in action, but the mixture is seen to be markedly more advantageous than either of the chemical manures mentioned above. When the attack occurs in the older crop no direct remedies are possible.

ENVIRONMENT AND DISEASE IN PLANTS

By

SUDHIR CHOWDHURY

All plant diseases whether parasitic or non-parasitic are profoundly influenced by environmental factors. The non-parasitic diseases are in large part if not entirely caused by the various factors of the environment. The occurrence of epidemics or the intensity of the parasitic diseases is largely determined by environmental factors. The different environmental factors which influence plant diseases are :

(1) *Physical condition of the soil*:—The physical make-up of the soil has an influence upon many plant diseases. It has been found by a general survey of the injury caused by yellow rust (*Puccinia glumarum*) in Germany that less damage is caused on heavy, deep and moist soils than on shallow dry soils The red rot of sugarcane has been found common on the stiff black soils of India but is rare on the porous 'bhata' soils.

(2) *Chemical composition of the soil* :—Chemical composition of the soil has an influence upon many plant diseases. In a general way fungi grow better in slightly acid media, whereas bacteria generally prefer a neutral or slightly alkaline reaction. The scab disease of potato has been found to be more severe in an alkaline soil while an acid soil has been found favourable for the development of the cabbage club-root organism. Johnson found that the growth of the tobacco root rot fungus, *Thielavia basicola*, is checked by a very high soil acidity. Sherwood conducted experiments with the tomato wilt fungus, *Fusarium* sp. and found that the highest percentage of wilt occurred in the most acid soils and that the amount of wilt decreased as the hydrogen-ion concentration of the soils decreased within certain limits.

(3) *Soil Moisture* :—For the well being of the crop an optimum range of moisture content of the soil is necessary. If the moisture content is too low drought may profoundly

affect the susceptibility of the crop, or it may have direct effect upon the activities of the parasite. In the case of cabbage yellows it has been found that strains of host plants normally resistant become attacked if deprived of water.* In dry soil infection of potato by *Synchytrium endobioticum* do not occur. Dickson found that low soil moisture favours infection of wheat and corn seedlings by the seedling blight fungus, *Gibberella saubinetii*. Hungerford secured the highest percentage of bunt infection in wheat sown in the soil with a moisture content of 22 per cent. Excessive moisture helps the incidence and intensity of numerous diseases but in such cases the factors of soil temperature and oxygen also probably come into play.

(4) *Soil Temperature*:—Of the fungi which require relatively high soil temperatures in order to establish infection the *Fusaria* are prominent; and it has been shown that at soil temperatures below 17°C. wilt of cabbage fails to develop. Jones, McKinney and Fellows working on the influence of soil temperature on the common scab of potato found that the scab organism is favoured by a relatively high temperature (about 22°C.) while the potato plant grows best at about 18°C. Hungerford states that he secured the highest percentage of bunt infection in wheat at a soil temperature of 9° to 12°C. Johnson has found that the *Thielavia* root rot of tobacco is of little importance at soil temperatures below 15° and above 30°C.; and the optimum temperature for its development ranges from 17 to 23°C. Richards states that the potato *Rhizoctonia* (*Corticium vagum*), does its greatest damage at a soil temperature between 15° and 21°C. with an optimum of about 21°, until at 24° the fungus proves to be of minor parasitic importance and at 27° or above few typical lesions occur. The optimum temperature for the development of the *Fusarium* wilt of tomato has been found to be 27 C. while at 17° or 35°C. the disease makes little progress.

(5) *Fertilisers*:—An excess of nitrogenous nutrition has long been known to predispose plants to some diseases. It has been found that susceptibility of potato to blight (*Phytophthora infestans*) increases by nitrogenous manuring ; sus-

ceptibility of wheat towards mildew (*Erysiphe graminis*) and yellow rust can be enhanced by supplying available nitrogen to the plants. Wheat and barley mildews have been found worst on plots supplied with nitrogen, especially that with nitrate of soda.

Phosphates are usually believed to increase resistance to disease but a few cases have been observed where they have been the cause of susceptibility. In lettuce mildew, phosphates have been found to diminish the resistance of the plants.

Salts of potash have a considerable reputation as essential to the maintenance of the natural powers of disease resistance in plants. Thus at Rothamsted, the potash-starved plots are always the first to succumb to parasites such as wheat and mangold rusts in bad years of disease. Growers of tomatoes under glass have found that the ravages of various fungi can be checked by potash manuring, and there are several other cases where the use of fertilizers such as kainit has been found to have a beneficial effect.

Lime has sometimes been found to increase liability to disease. The condition known as chlorosis may be induced by an excess of lime in certain cases. Larch canker is more severe on calcareous soils; and irises that prefer a limestone soil are liable to be severely attacked by *Heterosporium gracile* when grown in soil deficient in that substance.

(6) *Temperature and Humidity of the Air*:—Air temperature and humidity influence plant diseases to a considerable extent. Many observations over a long period of years indicate that outbreaks of the late blight of potatoes occur during seasons of excessive rainfall and sub-normal temperatures. Peach leaf curl is more prevalent when the early spring weather is wet and cold.

In wheat rust the determining factors in many parts of India is the humidity of the air in early months of the year. Certain observations indicate that it is the humidity of the air within the crop that is of importance, and that this may vary considerably with the density of the crop. In some

years the parasite is much more prevalent where the crop is heaviest; and there may be in the same field 20 per cent more moisture in the air within the crop in such parts, than in those with a light crop where rust is not severe. Lauritzen and Harter found that the percentage of infection of sweet potatoes by *Rhizopus* varies greatly with the relative humidity; only a small percentage became infected at relative humidities of 93 to 99 per cent, while at a humidity of 75 to 84 per cent almost 100 per cent, of infection occurred and at 51 to 52 per cent humidity very little infection took place.

Clayton has found that a soil temperature of 27°C favours the wilt of tomato only when the air temperature is 27°—33°C. When the air temperature is 17°C heavy infection occurs in the root and basal part of the stem but the plants grow thriftily and show no signs of the disease above ground.

(7) *Light and air* :—The influence of light is perhaps best illustrated by the powdery mildews. It is well known that many of these parasites develop most vigorously in shade situations. Wheat mildews in India has only been seen causing serious damage in half shaded pot culture experiments, and tobacco mildew is rarely destructive except where direct sun light is cut off. Shade has been reported to check celery leaf spot, asparagus rust, and the leaf diseases of strawberry in the United States of America. Shade also reduces chilli die—back in India.

Air is known to affect the growth of parasites in some cases. It has been established that some of the parasites of the wood of trees (*e.g.* species of *Fomes*, *Nectria*, *Valsa*) are only able to grow when they are well supplied with air.

Effect of Environment on Host versus effect on Parasite :—The question naturally arises as to whether these various factors of the environment exert a greater influence upon the host than upon the parasite or *vice versa.* This is a difficult question to answer but there seems to be evidence that in some cases the influence is exerted chiefly upon the host while in other cases it is chiefly the parasite

which is affected. In many cases there is probably a mutual influence exerted upon both host and parasite.

From a consideration of the environmental factors influencing plant diseases cited above, it will appear that these factors may easily determine either the regional distribution or the seasonal occurrence of a particular disease. Almost every year examples of the seasonal influence of weather on the distribution of plant diseases occur. This is evidenced by the fact that such diseases as wheat stem rust and late blight of potato occur in epidemic form during some seasons while they are practically absent in the same localities during other seasons.

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UNITED PROVINCES DEPARTMENT OF AGRICULTURE—MONTHLY AGRICULTURAL REPORTS

JULY, 1942

The rainfall was general and heavy throughout the province during the month of July, 1942, except for a short recess in the 2nd week when it was light in most of the districts. It was above the normal in some 24 districts, Dehra Dun recording the highest rainfall of 34·31″.

II—Agricultural operations.—Agricultural operations are in full swing. Preparation of land for *rabi* and *kharif* crops and the sowing of the *kharif* crop are going on. Weeding of sugarcane and paddy continued. Transplantation of paddy is also in progress. Harvesting of *ghuinyan* in the Etah District continued.

III—Standing crops and IV—Prospects of the harvest.—The condition of the standing crops and the prospects of harvest are, on the whole, satisfactory.

V—Damage to crops.—Some damage to crops by floods is reported from the Agra, Jalaun, Mirzapur and Ghazipur Districts. The standing crops in the Muzaffarnagar District are reported to have been affected badly by the floods. There is also a report of floods in the Kheri District but the extent of the loss is not yet known. There was a slight damage to crops in the Agra District by locusts also.

VI—Agricultural Stock.—Cattle diseases have been reported from some districts, but the condition of agricultural stock is, on the whole satisfactory. The figures furnished by the Director of Veterinary Services, United Provinces, tabulated below, when compared with those of the last month indicate less seizures by Rinderpest and Foot and Mouth diseases while in the case of Haemorrhagic Septicaemia the number is on the increase The number of deaths on account of Foot and Mouth diseases and Haemorrhagic

Septicaemia has increased, but in the case of Rinderpest it is on the decline.

Disease	June, 1942		July, 1942	
	Affected	Deaths	Affected	Deaths
Rinderpest	773	473	657	425
Foot and mouth	2,061	5	1,392	12
Hæmorrhagic Septicæmia ...	206	172	2,201	1,938

VII—Pasturage and fodder.—No scarcity either of pasturage of fodder is reported from any district except Ghazipur, where on account of the floods on both sides of the Ganges fodder is report to be insufficient in a number of villages.

VIII—Trade and prices.—There has been a somewhat marked fluctuation in the prices of barley, rice and arhar dal though the prices of wheat and gram remained more or less stationary with a slight tendency to rise. A comparative statement of the retail prices in rupees per maund prevailing at the end of the last month and at the end of the month under report is given below:

	End of June, 1942.	End of July, 1942.
Wheat	6·223	6·812
Barley	4·790	5·733
Gram	5·159	5·953
Rice	8·299	9·399
Arhar dal	6·995	8·073

IX—Health and labour in rural areas.—The condition of the rural population is generally satisfactory. Outbreaks of small-pox, cholera and plague are reported from several districts.

AUGUST, 1942

I—Season.—Rainfall during the month under review was general and heavy throughout the Province, being markedly higher on the whole during the second and third weeks than during the first and fourth weeks. It was above the normal in 30 districts, Dehra Dun recording the highest rainfall of 35·47".

II—Agricultural operations.—Agricultural operations are in full swing. The preparation of land for *rabi* is in progress. Hoeing and weeding operations on *kharif* crops continue and the harvesting of early *kharif* crops has commenced. The transplantation of late paddy has been completed.

III—Standing crops and IV—Prospects of the harvest.—The condition of the standing crops and the prospects of harvest are, on the whole, satisfactory.

V—Damage to crops.—Some damage to crops due to excessive rain and consequent floods, is reported from the Saharanpur, Muzaffarnagar, Aligarh, Muttra, Mainpuri, Etah, Bareilly, Bijnor, Moradabad, Shahjahanpur, Farrukhabad, Etawah, Jalaun, Banda, Ballia, Unao, Sitapur, Hardoi and Kheri Districts, but the extent of loss will not be known till the floods subside. A mild locust invasion is reported from the Jhansi District but there has been no damage to the crops.

VI—Agricultural stock.—Cattle diseases have been reported from some districts, but the condition of agricultural stock is, on the whole, satisfactory. The figures furnished by the Director of Veterinary Services, United Provinces, tabulated below, when compared with those of the last month, indicate less seizures and deaths by rinderpest while in the

cases of Haemorrhagic Septicaemia and foot and mouth diseases the number is on the increase:

Disease.	July, 1942		August, 1942	
	Affected	Deaths	Affected	Deaths
Rinderpest	657	425	343	154
Foot-and-mouth	1,392	12	2,006	36
Hæmorrhagic Septicæmia ...	2,201	1,938	2,797	2,319

VII—Pasturage and fodder.—No scarcity either of pasturage or fodder is reported from any districts.

VIII—Trade and prices.—There has been a somewhat marked fluctuation in the prices of wheat and gram though the prices of rice, barley and arhar dal remained more or less stationary with a slight tendency to rise A comparative statement of the retail prices in rupees per maund prevailing at the end of the last month and at the end of the month under report is given below:

	End of July, 1942	End of August,
Wheat	6·812	7·138
Barley	5·733	5·757
Gram	5·953	6·180
Rice	9·399	9·703
Arhar dal	8·073	8·292

IX—Health and labour in rural areas.—The condition of the rural population is generally satisfactory, although outbreaks of small-pox and cholera are reported from some districts.

"Of what avail
The plough or soil
Or land or life
If freedom fail"

Quoted by B. P. L. Bedi in "Harvest From the Desert."